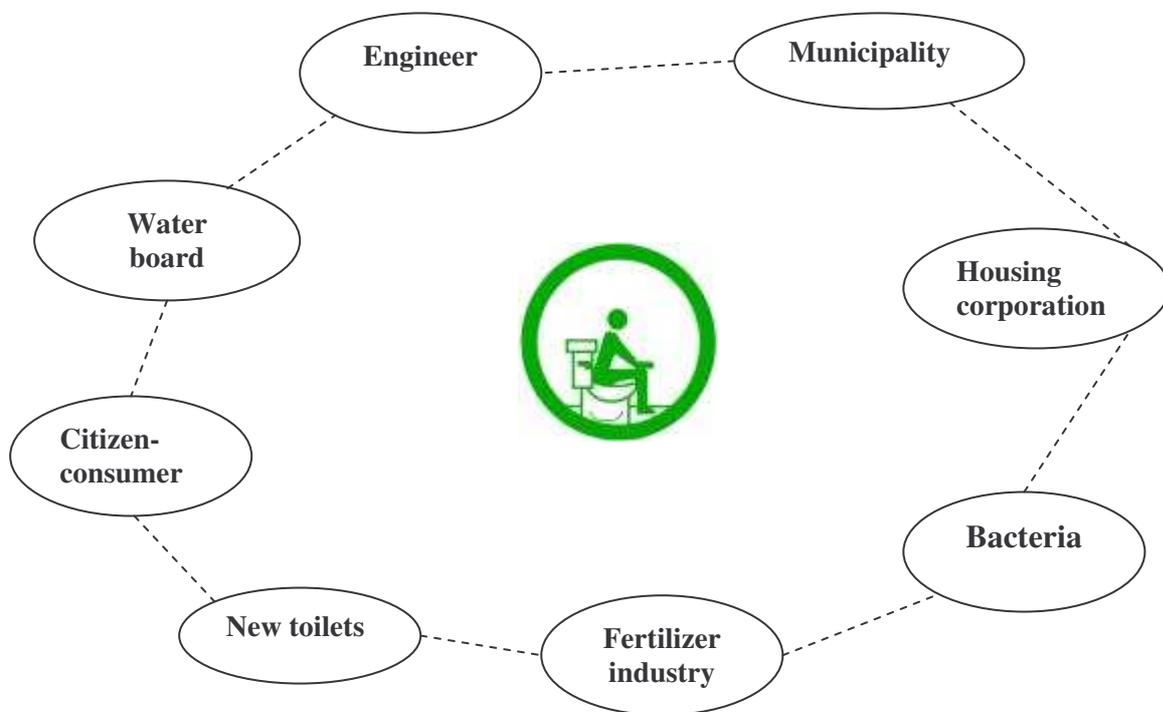


Trans(h)ition?

Exploring the actor-networks constituting the arena for a transition in Dutch sanitation

Jenneke van Vliet



Environmental Policy Group

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Wageningen, 2006

Thesis supervisors: Bas van Vliet and Dries Hegger

Environmental Policy Group

Social Science Group

Wageningen University

Preface

This thesis report on the development of alternative sanitation in the Netherlands is conducted in completion of the study Master Environmental Sciences at the Wageningen University. The inspiration to work on the subject of toilet waste came while traveling and working on organic farms in Spain. In the five months that I staid in the rural areas of Andalusia and Catalonia, I visited at least six different composting toilets, most of them dry or urine-diverting. This made me rethink our normally unquestioned sanitation practices and the huge system behind the collection and treatment of our excreta in the Netherlands. I thus immediately got enthusiastic when on return in Wageningen, I saw a call for a student willing to do a thesis on new sanitation at the Environmental Policy Group. A choice that led to surprise, sneering faces and giggling by fellow students: it was clear that this touched one of the last taboos of our society. Just a reason the more for me to take up the challenge of breaking open the ‘black box’ of our sewerage system.

During my research a large amount and diversity of sources were accessed in order to come to a balanced picture of the networks around alternative sanitation development in the Netherlands. This does not preclude the possibility that generalisations or simplifications are sometimes made amiss. However, the observations on the proponents of alternative sanitation are not just mine, but are for a major part based on the opinion of outsiders and hence give a good picture of how the proponents come across. This might well be different from the picture that the proponents themselves try to convey.

I am also aware that the department of Environmental Policy in which this thesis is conducted, is not a “neutral outside observer” of the developments, but is itself involved in the DESAR-project and in building up their own storyline or actor-world. Although I have of course made my own decisions and observations, this emerging storyline has influenced my research, and the conclusions or findings are therefore not entirely new. Nonetheless, the new empirical data from this research has helped to underpin them further, but also to extent, adjust, nuance or change them where necessary.

Finally, this research is not meant to be seen as a “political” stance, but as a critical analysis trying to come to constructive recommendations. The results, although firmly grounded on empirical and theoretical data, are presented as opinions which are of course open to discussion. I hope my work can form a contribution to the debate on new sanitation, but also to the wider debate on strategies for sustainable technology development.

I would like to thank Bas van Vliet and Dries Hegger for their supervision. Although their critical comments sometimes drove me crazy, they helped me structure my thoughts and this paper. Sharing news on the latest developments within our research field with Dries was always inspiring.

Special thanks also go out to all the people that contributed to this research by ceding me their time and energy for an interview.

Jenneke van Vliet

April 2006

Summary

A plea for radical change in handling toilet waste is made by some technical scientists and environmental organizations: away from the current sewage system towards source-separation and alternative treatment (like composting, anaerobic digestion or separate urine treatment). Arguments to underpin this plea are: the current system is spoiling drinking water, energy and valuable nutrients that could be used as fertilizer; it results in sub-optimum effluent quality (with regard to nutrients, medicine and hormone residues); it would be economically inefficient.

Their proposals for new sanitation would require big changes in technological infrastructure, but also in the institutions managing wastewater: new forms of cooperation are needed and possibly the involvement of third parties (like nutrient recyclers or energy companies). It also requires changes in users' behaviour and culture. It thus implies a multi-level, multi-domain change: a transition.

This thesis is an exploration of the “arena” for such a transition: a very diverse set of relevant actors in the field of sanitation development and their visions on the desirability and likelihood of a transition in black water handling. Interviewed were innovators developing alternative sanitation, representatives of the administrative bodies and their research institutes, but also potential nutrient recyclers. The empirical data are combined with the insights from theories on Transition Management and Actor-Network Theory. Transition theories offer a multi-phase, multi-level framework for analysing change of Large Technical Systems and for analysing the possibilities to steer this change. According Actor-Network Theory the success of a technological project depends on the successful build-up of a network of human and non-human actors and actants with aligned interests. ANT is used here to analyse the attempts of the proponents of alternative sanitation to enrol the necessary actors into their networks.

In this thesis the following core subjects are dealt with:

- The actors' perceptions of the current sanitation situation, the need for system change and of the different alternatives (composting, anaerobic digestion, urine separation).
- Special attention is paid to the role of nutrient and organic matter recycling: to its importance for new sanitation concepts, but also to the actual demand for source-separated urine, struvite and compost from toilet waste by the phosphate processing industry, artificial fertilizer industry and agricultural sector.
- The cooperation between the different groups of alternative sanitation-innovators and between these innovators and the parties they hope to enrol in their projects. Discussing why the engineers meet with little interest for their innovations and how they can enrol more parties in their projects.
- Identifying weak points in the actor constellations around new sanitation development in comparison to literature definitions of a *transition arena*.
- The chances and impediments for a transition in handling toilet waste on *landscape*, *regime* and *niche* level. Discussing the way current developments should be managed to enhance the chances for a transition and the role of different parties herein.

Main conclusions and recommendations are:

- The circle of those involved in the development or propagation of new sanitation is small and divided, although cooperation between the major part of the innovators goes well. Dispute exists concerning the choice of techniques (composting, anaerobic digestion and urine separation), concerning the importance of nutrient/ organic matter recycling, concerning strategies and over the role of the citizen-consumer. STOWA is the only regime party successfully enrolled in the development of new sanitation. Within the rest of the policy community appreciation of new sanitation is problematic and ranges from tentative enthusiasm by a few water boards, to neutrality

and scepticism of different degrees within other water boards, RIONED, RIZA, VROM and DG Water and rejection by many municipalities.

- Although there are several developments that can aid a transition towards source-separation (like the more stringent EU Water Framework directive standards, increased attention for energy saving and the risk of hormone and medicine residues), for the moment a real trigger is absent. Outside a small circle of ‘believers’ no sense of urgency for system change is felt: the current situation is not viewed as problematic; there is a strong belief in improvement through optimization rather than system change; alternative sanitation is seen as a very costly, low advantage option; impediments in the form of lock-in through the huge sunken investments in the current system and the socio-cultural robustness of sanitation practices are seen as too high.
- There exists a gap between the innovators/ engineers and the parties they want to enrol in their projects: especially the municipalities, housing corporations and national government are hard to get involved. Enhancing the network-building capacity of the proponents of eco-sanitation can be done by breaking self-referentiality in the communication strategies they employ. Self-referentiality can be noticed in the way the problems for which eco-sanitation offers solutions are presented; in the inadequate information offered to policy-makers and in the simplification of society’s interests by the ‘believers’. It is sure that the case for new sanitation cannot be won by technological and environmental arguments only, and more attention should be given to economic and socio-cultural issues.
- The pilots-projects or *niches* still have a strong technological focus (with only ex-post assessments of possible social and institutional ‘barriers’), while the major bottlenecks for innovation are of social-cultural nature. A more ‘systemic’ approach towards a transition of the water chain should be developed which takes on board the co-evolution of technology and institutional arrangements, cultural standards and social practices. Deliberate experimentation, monitoring and evaluation are required not only with different technological solutions, but also with different social constellations. This critique is not only valid for the case of alternative sanitation, but also for Strategic Niche Management as tool within Transition Management.
- The current network constellations around new sanitation development should be broadened and diversified to become a real transition arena. The support of regime powers is too weak and especially the early participation of municipalities deserves enhanced attention. The background from the involved is rather uniform – mainly coming from the wastewater chain – while for system innovation new alliances with nutrient recyclers or energy companies could be equally interesting.
- Naming nutrient recycling as advantage of new sanitation, leads to confusion in the Dutch context where there is no demand for source-separated urine and only very low demand for digestate or struvite. Moreover, finding answers on how to get rid of the toilet waste is essential for the advancement of new sanitation. Recommended is therefore to start now with the search for recycling options by involving the currently only interested organizations (Orgaworld and Amfert) in setting up a research agenda or starting local experiments.
- Government agencies and their advising bodies should beware of strengthening lock-in. Funding is not enough to create room for experimentation and keep a wide playing field; also legal room for alternative grey or black water treatment should be guaranteed and local experimentation with sewage fee discounts and different set-up of water bills should be supported.

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Chapter 1 Introduction

1.1 Problem description and background

1.1.1 'New' sanitation concepts

The current sanitation system in the Netherlands and other 'highly developed' countries is characterized by the unseparated and highly diluted collection, transport and treatment of toilet waste together with less contaminated household waste water (and usually together with rainwater) in a centralized system. This system, as set up from the beginning of the last century, has provided citizens with a very easy disposal of their excreta and urine and proved very effective in improving human health situation. However the downsides of our sewage system become increasingly clear: a high energy and drinking water consumption; the loss of valuable nutrients in urine that could potentially be recycled for agricultural use (in the light of declining phosphorus resources); wastage of a valuable source for biogas production (faeces); the increased contamination of surface water by medicines and hormones from human waste water; the rising difficulty of sewage treatment plants to live up to the more stringent EU effluent-norms for nutrients and contaminants as laid out in the new Water Directive; sewer overflows under heavy rain conditions leading to contamination of surface water (Mels 2005); the mounting costs of sewage infrastructure (Geurts *et al.*, 2004).

Over the years alternative solutions have been proposed to come to terms with these problems. Disconnection of rainwater has found wide practice in North-Western Europe and has become official policy in the Netherlands¹. More radical solutions entail the separation at source of all waste water flows and the (partially) local treatment and reuse. This latter group of innovations is termed 'Eco-sanitation' by various authors (Hegger *et al.*, 2005). Eco-sanitation² options include the separation of 'black water' (toilet waste) and 'grey water' (less contaminated water from kitchen, washing machine, shower etc); the local treatment in helophytes and reuse of gray water; the dry or water-poor collection of faeces in composting toilets or through vacuum toilets followed by composting or anaerobic digestion with the production of biogas; the separation of urine in urine-separating toilets for nutrient recycling, more effective removal of hormones and medicines and as a step to come to a more effective anaerobic digestion or aerobic composting of faeces.³ (Mels, 2005)

Eco-sanitation in Western countries is in its research and pilot project stage, but implementation outside the laboratory has turned out to be a complex affair. (It even remains a question whether it will get any further than pilot stage). In the Netherlands there are some examples of the separation and reuse of gray water, but separation or local treatment of black water hardly take place (Mels, 2005). Germany and Sweden are further advanced in this respect (with urine separation applied in x houses in Sweden). Sweden can be regarded as the first country in which eco-sanitation has entered the formal policy arena.⁴ On the contrary, in the Netherlands, Dutch municipalities are still trying their best to get

1 See for example, the Rijkswisatie Waterketen (2003)

2 As can be seen in chapter 4 even the term to describe the 'new' sanitation options is a point of debate. The terms eco-sanitation, alternative sanitation, decentralized and source-separated sanitation and 'new' sanitation are used for the same group of innovations. I will use the terms alternating throughout my paper. In interviews I started using the term 'new sanitation concepts' - naming the examples of black water or urine separation, composting and anaerobic digestion - as I felt it was the most neutral term, with the most positive connotation to it. Or I used the term 'source-separated sanitation', which is clear and without a controversial connotation (decentralized, ecological and alternative do have a negative or sheer ideological connotation for some of the respondents).

³ In chapter 3, the main technical concepts of alternative sanitation will be described further.

⁴ With obligations for the use of urine separation and/or composting toilets on local scale, like in the municipality of Tanum (www.tanum.se/miljo/planer_mal/urine_separation.htm, August 2005).

every house connected to the sewage system, exemptions only made in a few cases (and these houses than need to install a sub-efficient septic tank) (Mels et al, 2004).⁵

1.1.2 The 'software' of the system

It is not surprising that real-world implementation of ecosanitation is complex, due to the nature of urban water systems. "Urban water systems can be regarded as large technical systems, comprising both the actual technologies and the social organisation managing these technologies (e.g. Hughes, 1987). Besides technological 'hardware' (sewage pipes and wastewater treatment plants, both extended over a large geographical area) these systems also comprise sociological 'software', the social regime (Rotmans *et al.*, 2001). The term regime refers to a fine-tuned and interrelated set of elements (economical, cultural and institutional elements, but also the practices of the involved actors such as plumbers, policy makers, and citizen-consumers). Large technical systems have an advantage compared to new and competing technologies, because substantial investments have been made, institutions set up and trajectories of innovation set out. Therefore, the existing regime can often act as an inhibiting factor for the implementation of new technologies that implicate a step aside (Hughes, 1987), like eco-sanitation.

Since this 'software' is so decisive for the success of an innovation like eco-sanitation, sociological study into the possibilities of eco-sanitation is justified. The actors involved in the organization around separation and alternative treatment of black water in the Netherlands will be the focus of my research.

1.1.3 The 'potential transition arena'

A big set of very diverse actors are involved in the current or an alternative toilet wastewater system:

- Users/ households/ consumers
- Architects/ designer bureaus
- Engineer and consultancy companies
- Project developers of public or private housing projects
- Municipalities
- Water quality managers on regional and local level
- Research and knowledge centres
- NGOs with knowledge on the theme

To fully realize the eco-sanitation concepts at least the following actors seem necessary:

- Composting or manure processing firms
- Outlet market for reuse/recycling: the agricultural sector
- Energy companies

Making radical changes to the existing sewage regime towards a more sustainable sanitation system, could be called a transition (for an elaborate description of transitions and their management see Chapter 2). All the above actors are (at some point) needed in the transition process – they therefore form what I will name the 'potential transition arena'.

⁵ As an example of the position of eco-sanitation in official policy: Waterschap Zuiderzeelanden states in their latest water management plan that the reuse of effluent from the sewage purification plants is not being considered at all, due to the low societal acceptance and needed investments. Also the drinking water companies are said to give the issue a very low priority. Furthermore, the local reuse of waste water is seen as to big a threat to public health and local water quality. http://www.zuiderzeeland.nl/water-beheersplan/tekst_van_het_plan_0/7_-_het_te_voeren/7_3_-_water_in_het/7_3_4_-_zuivering (August, 2005)

Figure 1.1 The potential transition arena

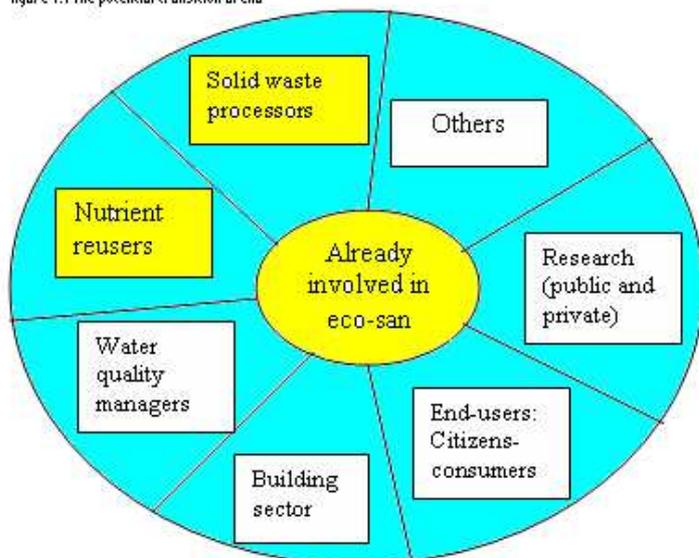


Figure 1.1 represents this potential transition arena. The different sectors are represented by the wedges of the pie. The middle circle represents the actors who are already involved in promoting or setting up research and pilot projects about the alternative treatment of toilet waste. The wider dark circle represents actors that are not yet involved, but whose involvement is assumed⁶ to be a condition for the development and implementation of new sanitation concepts.

However, little is known on their expectations and visions for such a transition; what roles are they willing

to take on in the process of development and implementation of eco-sanitary techniques and new modes of cooperation; and what would they like others (amongst which the government) to do; are there any opportunities for strategic alliances?

Especially actors in the processing and re-use/recycle stage hardly seem involved in the development of the new technologies. Interesting in this respect is the influence of the agricultural sector as a major contributor to research on urine separation in Sweden⁷. Is a similar support from Dutch farmers' organisations expectable?

1.1.4 Transition management

The Dutch government has increasingly become aware that classic policy fails in solving some of our big environmental problems, and in 2001, 5 Dutch ministries adopted the new governance approach of transition management, which was presented in the fourth National Environmental Policy Plan (NMP4). A long-term, integrated approach addressing problems of uncertainty, complexity, and interdependence is needed to deal with problems that are seen as intrinsic to fundamental system design aspects ("system inherent weaving faults") instead of related to particular technologies. Transition Management's central question is: how can be worked from the existing situation towards a desired end picture? The Ministry of Economic Affairs has been very active since 2001 in developing transition policies for the transition to a sustainable energy-supply system in 2050⁸, involving various stakeholders (companies, researchers, NGO's). (Kemp & Loorbach, 2003)

Sanitation has not yet been appointed as an area for transition policy. Would there be any possibility for setting up such a policy in this area? What do different actors think of this? Which of them wants to be and should be involved? How should such a policy be shaped in the case of black water separation and treatment? What should be the role of the government as a special actor?

⁶ Assumed by the author, one of the research questions is to find out whether this is the case according to the different actors.

⁷ The housing and agricultural sectors have made the largest contributions to research. The water and wastewater sector has also made a large contribution, while the contributions by other sectors of society, for example the environmental sector, have been small. (Jönssen, 2001)

⁸ www.energiemtransitie.nl

1.2 Problem definition

The current sanitation system in the Netherlands has several ecological drawbacks. There exist technological alternatives that seem more sustainable in ecological (and maybe also in economic) terms, but these are still in the research and pilot project phase. Since urban waste systems are large technological network bound systems, implementation of innovations are difficult to effectuate. For implementation not only changes in the material system of pipes and toilets are necessary, but also in the social organization and practices that form the ‘software’ of the system. However, little knowledge is available on the ideas of actors that (should) form the network around the implementation of alternatives for the handling of toilet waste. A common vision(s) on how to make the transition to a more sustainable sanitation system seems to lack.

1.3 Aim of the study

The aim of my research is to give insight in (part of) the potential transition arena for a sanitation transition in the Netherlands away from the sewerage system towards more sustainable ways of managing toilet waste. I will focus on the following groups: 1) the actors already involved in the development of alternative sanitation 2) the potentially relevant actors for the processing and reuse of (minerals coming from) toilet waste. I will look into: the existence of (a) network(s) on alternative treatment of black water; who is involved and who is excluded; the actor’s current roles and cooperation practices; their policy (if in place) or visions for the future for black water; their envisioned roles in the development and diffusion of alternatives; their expectations towards other actors, among which the government; their ideas on a deliberate ‘transition management’. From my research suggestions will come forward for cooperation opportunities and improved policy.

I do want to make very clear that I do not *ex ante* suppose that we are at the start of an actual transition towards a more sustainable sanitation system, nor that the (desirable) outcome of such a transition would be an ‘eco-sanitary’ system, where black water or urine separation takes place. It is precisely subject of research whether a transition is desirable and likely and whether the different alternative techniques of eco-sanitation should play a role in that transition.

1.4 Research questions

For this research I have identified two main research questions, which I have split up into several sub questions:

- **Which actors comprise the potential transition arena around managing toilet waste in the Netherlands and what is their current involvement in eco-sanitation; what relations do they have with the other actors; and which views do they have on black water treatment (current and alternative)?**
 - Which actors are currently involved in thinking or acting on eco-sanitation in the Netherlands?
 - Can we talk of one network on the issue and if so, who are involved/ excluded? Or are there separate clusters of actors?
 - Which actors are deemed necessary (by the interviewed) for a transition, but are currently not involved?
 - Why are these actors not involved, according to themselves and according to the actors that make the small circle of the involved?
 - Under which terms would stakeholders be willing to enter the transition arena (in the sense of opening the way for consultation with other actors, contributing to research, (pilot) projects etc.)? Which factors would facilitate entrance?

- How are relations between the actors (both involved and not yet involved): antipathy/sympathy, is there communication and how often?
 - Which actors are most powerful/ cannot be left out? What are their sources of influence/ power?
 - Which problem definitions dominate in the potential transition arena with regard to the current black water treatment?
 - What are the current policies and future visions of the main actors with regard to eco-sanitary solutions?
 - What are the ideas on processing of the toilet waste and reuse of the nutrients or organic matter from the product, according to the interviewed and according to literature?
- **What are the visions of the actors in the potential transition arena on effectuating a sanitation transition – away from the sewerage system towards eco-sanitary ways of managing toilet waste - in the NL?**
 - What do they think about the need and likelihood of such a transition?
 - What do they think would be the biggest impediments for such a transition to occur?
 - Which roles are actors willing to take on in different stages of the transition – in development of techniques, developing common visions, being an initiator or (reluctant) follower, cooperation with others in setting up pilot-projects etc.?
 - What are their expectations towards other actors?
 - Where can strategic alliances be made according to the actors?
 - What are their views on a deliberate transition management? (possibilities, usefulness etc.)
 - Do the actors have suggestions for improvements in the network? Who should, according to the actors, manage the network and how?
 - What are the actors' opinions on the role the government (as a special actor) should take on? How could, according to them, policy be improved?

1.5 Research strategy and methods

My research is of an entirely qualitative nature. Although theoretical research is part of this thesis, the emphasis has been on empirical research as I believe talking to the people in the transition arena enhances the practical utility of my thesis and gives more insight into the practical applicability of the transition management theories.

In the preparatory phase, I tried to get a good background overview on both the theories that seemed useful and of the empirical situation at hand. This was mainly done through literature study and talks to D. Hegger, B. van Vliet, my supervisors from WUR who were already involved in the DESAR-project and M. Geurts and G. de Bruijne from WASTE. From this I got an idea of knowledge already available, where information gaps or research opportunities were and got a preliminary idea of the relevant actors. This helped to focus my research and to formulate research questions coming forth both from the practice and the theory.

I decided to investigate the opinions of the actors in the 'small circle of the involved' (see figure 1.1) and explore part of the wider potential transition arena, namely the solid waste processing and nutrient reusing/recycling sectors. In the first group I expected the likelihood for more elaborated visions on effectuating a sanitation transition biggest. At least the actors would have previous knowledge on the issue, have showed willingness to think about the subject and have encountered some obstacles to a transition in practice. The 'solid waste processors' and 'nutrient reusers/recyclers', on the other hand, seemed the group that at the moment is least involved and little knowledge on their visions is available. However, their role seems crucial for the success of eco-sanitation and is presupposed by

the proponents in their ideas of ‘closing the loop’ with agriculture. The need for research on this group becomes clear when looking to their negligible part in discussions and pilot projects; they are hardly specified in research documents (“nutrients become available for agriculture” is about the most specific it gets). This need was also expressed in publications of Geurts (2003) and talks with WASTE.⁹

Major activity in this research was obtaining information on the actors and their visions. This information was obtained through interviews, email enquiries, and text analysis of policy documents, speeches, earlier interviews etc. by these actors. In writing this paper it was supplemented by information obtained from literature search, amongst other on the possibilities for recycling/reusing of toilet waste (or nutrients out of it). Also for the Conceptual framework literature study was naturally used.

My research aim was twofold: a) I wanted to find out which actors could be relevant for a transition and b) from these relevant actors I wanted to know their visions on the need for change towards separate black water collection/treatment, how to achieve this, their envisioned role etc. Therefore the definitive list of people/organizations to be included in my research could not be designed beforehand; during the research some actors turned out to be relevant and were added and others were left out, because I did not expect their story to add new information¹⁰.

For my investigation on the first group, I included people and organizations that were often named in research literature or in texts on pilot-projects. The project ‘het Nieuwe Plassen’ in Meppel initiated by Grontmij and the DESAR research provided good starting points.

For the second group M. Geurts from WASTE provided me with contacts for Thermphos International BV, the BVOR and Orgaworld. The idea to include the artificial fertilizer industry came from W. Schipper from Thermphos. Further suggestions for interviews in both groups came from the interviewed themselves or from my own internet enquiries.

My deliberate intention has been not to order the interviews so that first all interviews of with the small circle of ‘the involved’ and then all the interviews with the wider circle would be done or the other way round. I deliberately chose a strategy in which they alternate, so that I could confront the actors with opinions of those interviewed before from the other sector.

The interviews were done both face-to-face (with the most important actors, for first encounters or longer interviews) and by telephone. Short information about the aim of the research and questions to expect was given beforehand by email. Interviews were semi-structured: starting with several start-off questions on each item, but later questions not fixed beforehand. Questions were open. The interviews were not standardized: not all informants were given the same start-off questions, the range of issues included also differed. This was because of the differences in acquaintance with the subject and their role in the ‘network’. Questions on their contacts and cooperation with others, their involvement in alternative sanitation development and on the roles they could envisage for themselves were always included. A check-list can be found as Annex.

I was able to attend part of the PAO course “Gescheiden inzameling en behandeling van stedelijk afvalwater” in Wageningen at the 18th of November. I got some interesting information out of the

⁹ In my research I pay little attention to the consumer/citizen who is going to use the new toilets. This is only due to time limitation and does by no means imply a perceived lower importance of research among this group. Moreover, I would welcome a Dutch research on this theme, making reference to the research already delivered for Switzerland by Pahl-Wostl et al. (2003). A small beginning has been made by Geurts and Bijleveld (2003) for WASTE. A PhD on the role of citizen-consumers in innovations in the wastewater chain is currently undertaken by D. Hegger at the ENP department of WUR.

¹⁰ For the complete list of interviewed see References.

presentations, but above all it was interesting to see a bit of the interaction between the participants from different backgrounds.

In my research no clear phases can be distinguished of data gathering and data analysis: analysis took place continuously. On the basis of the analysis of the newly acquired information, I re-adapted question lists and the choice of the next interviewed. I developed hypotheses that I tried to test in new interviews or through literature. In the same way, theory development alternated with empirical research in an iterative process.

1.6 Report layout

In Chapter 2 the theoretical framework of my research is presented: a combination of Actor-Network Theory and theories on Transition Management.

In Chapter 3 background information on eco-sanitation concepts and techniques is provided for readers not informed on the issue.

In the Chapters 4, 5 and 6 we find the empirical part of the research. In Chapter 4 the relevant actors are introduced. Their perceptions of the current sanitation situation and of alternatives are treated. The perceived need for change and their views on the recycling of toilet waste are analysed.

Chapter 5 treats the interaction between the actors. Different innovation networks around alternative sanitation are distinguished. Cooperation between the innovators and between the innovators and the parties they want to enrol in their projects is looked at. Difficulties in these relationships are analysed by using Actor-Network Theory.

Chapter 6 is structured by concepts from theory on Transition Management. The chances for a transition in black water handling are evaluated by making use of the multi-level, multi-phase framework. Attention is paid to the possibilities for steering and the responsibilities of different actors herein. The innovation networks identified in Chapter 5 are compared to literature definitions of a transition arena, which leads to recommendations on broadening the network.

Chapter 8 presents conclusions, discussion and recommendations. Conclusions are drawn on empirical and theoretical level. The value of the theoretical framework for this and future research is evaluated in the discussion. Recommendations are made to improve both theory and practice.

Chapter 2 Theoretical framework: Actor-Networks and Transitions

2.1 Introduction

In this chapter I will introduce the two theories that will together form the theoretical framework for my research: the Actor-Network Theory (or Actor-Network Approach) and Transition Management theory. The concepts will be presented which I will use for the design of my empirical research and subsequent analysis of forthcoming data. Aim is to show why I believe the combination of these two theories – that may seem odd at first – can help to answer my research questions. That is to say: how they can give a clear and balanced picture both from the networks around sanitation development and the interaction between the actors in these networks, as well as from the larger trends that influence the development of alternatives.

I feel that to understand the proposed theories and the choice for these theories well, it is important to have an idea of where they stand in the tradition of theories on technology development and the relationship of technology with society. Therefore I will shortly introduce their background by sketching the debate on determinism and agency in section 2.2. The presentation of Actor-Network Theory will then take place in 2.3, Transition Management in 2.4 and evaluation in 2.5.

2.2 Finding the right position

2.2.1 *From determinism towards contextual approaches*

In the tradition of sociology and technology studies we find a wide array of views on the relationship between technology and society. The several views on technology development can be characterized by a difference in the scope they leave for social and economic factors and for strategic ‘agency’ of individual actors (Belt, 2001). Adoption of each of the views thus has implication for the possibility of steering the development and implementation of any technologies by societal actors.

Technological determinism explains technological development out of the internal dynamics and logic of science and technology (as applied science). No steering of its direction by societal factors is possible; the course it follows is determined solely by the efficiency criterion which is conceived as a natural law. But in its turn, technological development does affect society, which therefore needs to adapt itself continuously (Mol, 1991). By representing the actually realized trajectory as the only possible route, technological determinism obscures the actual choices that were made by real people in the course of the development. Critique on determinism is underpinned by historical examples, which show that there were alternative lines of development, that could equally have been ‘chosen’. (Belt, 2001)

Later on neoclassical economists nuanced this view, by showing that technological innovation is not only ‘pushed’ by developments in science and technology, but also ‘pulled’ by market demand. (Mol, 1991: 57) This was the first step in criticising the autonomous character of technology-development. But instead of putting an end to determinism, these theories rather replaced it by an economic-technological determinism.

Others within the economic tradition, mainly Nelson and Winter and Dosi (in Mol: 1991) went a step further away from determinism, by focusing attention on the role that socio-cultural and institutional factors play in processes of innovation and diffusion of technology. Their contributions together with those from social sciences opened the way for what are being named ‘contextual approaches’ of technological development. Both the Actor-Network Theory (ANT) and the theories on Transition Management (TM) belong to the ‘contextual approaches’, although they differ considerably amongst each other. They built forth on other theories in this category, in which three diverse, frequently used, theories can be distinguished: the Nelson-Winter/Dosi model, the ‘social construction of technology’

and the technological system approach. Where TM builds forth mainly on the N-W/D model and the technological system approach, ANT could be seen as an elaboration of the last two approaches.

2.2.2 Nelson-Winter/Dosi model

Central notions in the Nelson-Winter/Dosi model are the idea of technological paradigm or regime – which plays a big role in TM, although in a broadened version - technological trajectories and the selection environment. A technological regime can be conceived of as “the dominant cultural matrix of technology developers and encompasses a limited number of scientific principles, insights and heuristics and a limited number of artifacts” (van Vliet 2002: 33). In this evolutionary theory, technological development is conceived of as succession of variation and selection processes within society, that do not occur ad randomly, but within the limits set by the regime. Starting off from an ‘example or basic technology’, the direction of change is shaped by the heuristics – this prestructured direction is called a technological trajectory.

On the one hand, the existence of a regime facilitates rapid technological change within its boundaries, as all conditions in terms of required means and minds have already been set. On the other hand, as all new problems are treated with the same heuristics and within the same trajectory of development, the regime and trajectory become relatively inert. Radical change, in the sense of regime change, occurs only rarely.

The good thing of the evolutionary theory is that it shows the complexity of the selection process that can take place either between paradigms, between trajectories and within trajectories. The environment within which selection takes place has been identified as a whole of actors, factors and institutions, divided in three dimensions:

- Science and technology, including knowledge and knowledge of infrastructure and existing artifacts;
- Economy, including factor costs, consumer demand, modes of production, level of competition etc.,;
- Socio-cultural and political basis: power balances, dominant policy styles etc. (van Vliet, 2002; 34)

Critique on this theory is the presentation of the selection environment as autonomous, whereas as Van den Belt and Rip (1984) state; not only does the selection environment influence technological-development, but it is itself also changed by this development.

2.2.3 Social construction of technology

Whereas in the evolutionary view technology possesses a certain internal dynamic making its development still relatively autonomous, the ‘social construction of technology’ theories leave behind the autonomy of technology altogether. And whereas in the former a division between the technological domain and the economic and socio-cultural domain is made, in the latter the difference between the technological, the social and the economical seems to have vanished.

The socio-constructivist view as developed by Pinch and Bijker (1987) radically quits with technological determinism, stating that the process of variation and selection is not one but multi-directional. It considers technology development as being an outcome of an (unequal) struggle of interest groups, which also defined the problems in the first place. Problems are solved by technology as soon as the most relevant groups conceive them as being disappeared: this can be attained by developments in the technology, but also by changes in the definition of the problem, as new social groups manage to get their views accepted as ‘reality’. (Mol 1991, van Vliet 2002)

The early work by Callon (1980 and 1987), who is one of the developers of ANT, emanates from the same school of thought. Based on his insights from a study on the development of the electric car in France, he shows how social, economic and technical factors are so intertwined in a network that they can no longer be distinguished. Because what is being defined by one person as technological is by another seen as a social phenomenon. This also renders the division between technology developers

and those social groups that suffer the problems (for which solutions are to be found) impossible. “According to Callon we can speak of a network of actors and artifacts that not only try to develop and introduce a technology, but are simultaneously (re)defining societal problems. The outcome of the process of technology development is ultimately determined by the power of a certain group of allied actors that with its ideas succeeds to transform the society by technological change.” (cited in: Mol 1991: 63)

Illustrative of the SCT are Carlson’s (1992) remarks about how inventors are often characterized as problem-solvers, but should be seen as bundles of solutions who construct problems suited to their unique skills and ideas. Indeed, problems are not ‘out there’, waiting for inventors to find and solve them: there was no ‘telephone’ problem waiting for Bell to solve it and thus his genius lay in not only devising a telephone, but in constructing the problem of the electrical transmission of speech in the first place. Carlson would say that like Edison was interested in electromechanical elements and looked for opportunities to apply these, the same might go for the WUR Environmental Technology Department with anaerobic digestion.

Especially in the work of Pinch and Bijker technological development is completely explained in terms of a social struggle of interests, paying hardly any attention to the role of existing technological structures in the development of new technologies. This seems already questionable when keeping in mind single technologies – as was mostly done when the above theories were developed – but is definitely a step too far when large technical structures are concerned.

2.2.4 Technological system approach

Sewerage, like the electricity grid, piped gas system, drinking water or cable television are all network-bound systems: physical networks (cables, pipes, tracks) link providers and users. Network-bound systems are a specific category of large technical systems (LTS). LTS can be defined as “a range of interconnected technological artifacts as well as social actors managing, using and regulating these systems” (van Vliet, 2002: 35). LTS and especially their network bound versions - like the Dutch sanitation system - are very difficult to change and change will normally be a slow process. In the case of these large technological networks it will be too hard to neglect the role of already existing infrastructure and technology in processes of change. “Technological trajectories seem nowhere as evident as in circumstances of fixed networks, where large scale investments have accumulated over the years and physically impede changes or alternatives to the basic features of the system”(van Vliet, 2002: 35).

Theories keeping LTS in mind were developed by, amongst others Hughes (1983, 1987), Weingart (1989b), Callon (1987) in his later work and Summerton (1994). The change of LTS is the core subject of theories on transitions and Transition Management. Actor-Network Theory does not specifically focus on LTS. Callon would argue that any technological change irrespective of its scale is a system change, involving the de- and constructing of networks. The technological system theories divert from the evolutionary approach, by drawing those factors that comprised the ‘selection environment’ in the Nelson-Winter/Dosi model – the environment that influenced technological development, but was itself hardly influenced by technology – into the system approach as a dependent variable. Constant correlation and mutual influence takes place in LTS between technology-in-development on the one hand and the economical, socio-cultural and technological structure on the other hand. (Mol, 1991: 64)

Some authors, like Hughes (1983 and 1987) stay closer to the evolutionary way of thinking than others like Callon and Latour. There is also a big difference in the attention paid to the actors involved in building up a system, regime or network. Hughes does not treat them as more than ‘functional units’ of the system. In 2.4 we will notice that also in Transition Management little attention is paid to the role of individual actors: a theory on agency seems lacking. On the contrary, Callon and Latour with their Actor-Network approach do give ample attention to the actors involved and their intentions. They

say that ‘development of scientific knowledge and technological systems cannot be understood unless the simultaneous reconstruction of social contexts of which they form part is also studied.’ (van Vliet, 2002: 37/38)

2.3 Actor-network approach

2.3.1 *Dissolving the technology-sociology divide: building actor-network*

First of all, what is often named actor-network theory (ANT) was never meant as a theory according to Latour but more as an approach for doing research on science, technology and society with which the methodological trap of splitting these up in dichotomies and categories like nature-society, technology-society, economic-social, engineer-citizens, but also micro-macro, actor-structure and context-content could be avoided. (Latour, 1994) It claims to deliver a non-dualistic standpoint by focusing on how things are ‘stitched together’ across divisions and distinctions (Murdoch, 1997: 322). It departs from the ‘social construction of technology’ theories by criticising the a priori attribution of social interests; the idea that technology development can be explained from *existing* social structures and power relations. It rejects this ‘social determinism’ by showing that innovators can with their technological innovations also change social relations. (Belt, 2001) ANT pretends to put an end to the debate between proponents of ‘technological determinism’ and ‘social determinism’ by rejecting the common assumption that both society and technology exist independent of each other. (Verschoor 1997: 29)

Main thesis of their work is that socio-technological development can be described as the “progressive constitution of a network in which both human and non-human actors assume identities according to prevailing strategies of interaction.” The successful development of a technology requires the ‘engineer-sociologist’ to build up an actor-network: a heterogeneous network of aligned interests. The actor-world “defines the identity of all the elements, the roles they should play, the nature of the bonds that unite them, their respective sizes and the history in which they participate” (Callon, 1986) Heterogeneous as it consists not only of human actors (institutions, groups and individuals), but also of non-human actors and actants (being animals, genes, texts or machines) and entails relationships that cannot be neatly named in the conventional sociological categories (contract, domination etc.). In his example of the electric car in France, Callon shows how its development is not only dependant on the will of consumers, political and market parties to support the project, but just as much on the possibility to make lead accumulators with improved performance, which again depends on the functioning of electrons jumping between the electrodes.

Since technical objects must be seen as a result of the shaping of many associated and heterogeneous elements, they will be as durable as these associations, neither more nor less. (Callon, 1986) It is exactly the heterogeneity that lends stability to the network: social relationships in general and sanitation practices need to be materially grounded in order to acquire temporal and spatial endurance: there is no social ordering without the material framing of social relations. Left to their own devices, human actions and words do not spread far at all. On the other hand objects must be symbolically framed in order to acquire status (van der Duim, 2005), for example as a trustworthy, hygienic or luxurious sanitation system.

The main critique on ANT is the attribution of agency to non-human actors. Some say that in this way determinism enters the scene again. This critique is only partially retaliated by making a crucial division between actors and actants: while both share the scene in the reconstruction of the network of interaction leading to the stabilization of the system, only actors are able to put actants in circulation in the system.¹¹

¹¹ Bardini, http://carbon.cudenver.edu/~mryder/itc_data/ant_dff.html (March, 2005)

2.3.2 Translation

What actor-network theorists seek to investigate are the means by which associations come into existence and how the roles and functions of subjects and objects, actors and intermediaries, humans and non-humans are attributed and stabilized (Murdoch, 1997: 331). Or said differently: how actor-networks are created by 'translation', a process consisting of three major stages: *problematization*, *interessement* and *enrolment*. During the problematization phase the focal actor defines identities and interests of other actors that are consistent with its own interests, and establishes itself/its own project as an obligatory passage point – a situation that has to occur in order for all the actors to satisfy the interests that have been attributed to them by the focal actor - thus "rendering itself indispensable". In the interessement phase of translation the other actors then have to be convinced to accept the definition of the focal actor. Once they accept this, they are 'enrolled' in the actor-network. (Callon, 1986)

Translation refers to the processes of negotiation, representation and displacement between actors, entities and places. To translate is to speak for the other elements, to convince them of your representation of their interests or said otherwise to make them accept you as your spokesman and to convince them of your indispensability. The 'interpretive flexibility' of a project becomes clear: the project often means different things to different actors. The development of solar energy may mean a good step in environmental improvement for environmentalists, work and credits for a bunch of engineers, a business opportunity for Shell and a threat to the Exxon Oil company. A network-builder tries to use this interpretive flexibility in a smart way while presenting his/her project.

But translation cannot be effective, i.e. lead to stable constructions, if it is not anchored in movements of physical and social displacements: the inscription of translations in mediums like reports, survey results, scientific papers and movement of people to meetings, symposia take place. There are also movement of materials and money. (Callon, 1986)

Of course the process of translation is not without resistance and defiance and often fails, thus leading to the abandonment or revision of a technological project. During the process of translation, 'simplification' takes place: an infinitely complex world is reduced to make it into the focal actors' 'picture'. For example, towns consist of more than public transport, the wish to preserve town centres and the town councils that constitute their spokesmen. They differ from one another with respect to population, history and geographical location. However, in the storyline of the developers of the electric car in France they were reduced to a transport system that must avoid adding to the level of pollution and a town council that seeks to advance towards this goal. When these simplifications could no longer be maintained – the town council appeared unrepresentative; living conditions in different neighbourhoods could not be reduced to those in the town centre; and the system of public transport is but one aspect of a larger urban structure – resistance to the translation occurred. (Callon, 1986: 28/29)

Around an existing technology or scientific idea the network patterns can become routines that are more or less taken for granted and unquestioned. The network is 'veiled', the artifact or other element becomes a 'black box'. Our flush toilet can be seen as such a black-box: as long as nothing goes wrong, we normally do not realize the network that is behind it. 'Black-boxing' makes life a lot easier, as it allows people to take the work of others as a resource (which may come in the form of devices, texts, standardized sets of organizational relations, boundary protocols etc) and move on, rather than continually reproducing and questioning it. (Law, 1992)

2.3.3 The successfulness of a project

In 1992 Callon writes that the success of a socio-technological project - like the development of new sanitation concepts by different innovators - depends on three factors. First, the capacity of the project to build and maintain a *global network*: a set of relations between an actor and its neighbours on the one hand and between those neighbours on the other. It is a network that is built up, deliberately or

otherwise, and that generates a space, a period of time and provides resources of various kinds in the expectation of intermediaries and ultimate return (offering privacy for trials, control over the outcomes and a degree of autonomy). It provides a *negotiation space*.

Second, the ability to build a *local network* using resources provided by global network to ultimately offer a material, economic, cultural, or symbolic return to the global network. This requires the ability to experiment, learn, to put something together, to keep the control over what has been produced and to satisfy the actors in the global network. As the definitions show global does not necessarily mean geographically distant and local does not necessarily mean geographically close.

Third, the capacity of project to impose itself as an *obligatory point of passage* (OPP): a single locus should shape and mobilize the local network and this locus should have control over all transactions between the local and global networks. Otherwise the project managers have no control over the resources, which may be misused or withdrawn; it cannot claim the successes either, so it does not profit from local network. When ‘seepage’ takes place – local actors lobbying their global counterparts – the OPP is not established and the project may fail.

Another factor that can be taken as a sign of success is whether the project has gained *momentum*. Momentum denotes the way in which the past engages the future: transactions that have taken place which cannot easily be undone, influence future choices and thereby add momentum to the project. For example, when starting a store, the signing of contracts to the bank adds to the momentum, as well as giving up one’s former job or the amount of products in the storage. This has to do with the evolutionary process in which a project passes from a stage of uncertainty to a stage in which trajectories stabilize. This is often the case when a project is successful, i.e. able to present a result; when ideas (which are debatable) make way for finished objects (which are less debatable). (Verschoor, 1997)

2.4 Transitions and the attempt to manage them

2.4.1 Theories of transitions

The replacement of the current sewerage system by a radically different and more sustainable system could be called a transition: “a gradual, continuous process of change where the structural character of a society (or a complex sub-system of society) transforms over a generation or more.” For a transition to occur, connected changes must take place in several different areas, such as technology, the economy, institutions, behaviour, culture, ecology and belief systems. (Rotmans et al. 2001, pp15) In the social organization around transitions three levels can be distinguished:

The *socio-technical landscape* relates to material and immaterial elements at the macro level: material infrastructure, political culture and coalitions, social values, worldviews and paradigms, the macro economy, demography and the natural environment. This level typically responds to relatively slow trends and is hardly manageable by the actors on the meso level.

The meso level of *regimes*, defined by Rip and Kemp (1998) as: “the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artifacts and persons, ways of defining problems – all of them embedded in institutions and infrastructures”.¹² At the meso level are the interests, rules, dominant

¹² Note that this is a reinterpretation of the notion of technological regime by Nelson-Winter/Dosi, who used the term to refer to a cognitive framework embedded in the minds of engineers. Influenced by the social constructivism, Rip and Kemp argue that a technological regime is the outcome of the coevolution of the technological, economic and social elements. A regime therefore not only exists in the cognitive heuristics or guidelines of designers but is embedded in legislation, dominant technological practices, and institutions. (Raven & Verbong, 2004) This widening also means that more social group are taken on board than engineering communities. Technical trajectories are not only influenced by engineers, but also by users, policy makers,

practices, shared assumptions and beliefs granting the system stability and guiding private action and public policy – for the most part geared towards optimizing rather than transforming systems. In the first transition phase the regime often acts as an inhibiting factor, but later on – once a new technology system comes into its own, the regime can have an enabling role, through the application of large amounts of capital and organizational power. (Rotmans et al. 2001: 19)

The *niche level* (micro) relates to individual actors and technologies, and local practices. At this level, variations to and deviations from the status quo can occur, such as new techniques, alternative technologies and social practices (innovations in institutions and behaviour). (Rotmans et al. 2001: 19) The niche may be a market niche or a niche created by a company (sponsoring a new technology) or government. (Kemp & Loorbach, 2003: 9)

Changes can start at every level and in every domain, but the multilevel aspect of transitions implies that change only breaks through if developments at one level gel with developments in other domains and if interactions between the developments on the micro, meso and macro level take place. (Rotmans et al. 2001: 20). It is mostly at the niche level that radical experiments take place. However it is incorrect to suggest that niches are simply waiting ‘out there’, as many niches were created by landscape elements. For these niche-innovations to ‘stir’ something on regime level, they need ‘windows of opportunity’. These are created when linkages are weakening or ‘the configuration becomes warm’ (in Callon’s words) due to tensions in the regime. These tensions indicate uncertainty and differences of opinion and can be caused by internal dynamics (confrontation with problems) or external pressure (like changes in the landscape). One of the comments to the transition theories is that they are unclear about the steps between niches and regime change, and between regime change and landscape changes. Geels (2002) did some work on this in describing how niches usually breakthrough to regime-level, following a general pattern of trajectories of *niche-cumulation*. The step to regime-level is not taken at once, but gradually as radical innovations are used in subsequent application domains or market niches, i.e. a cumulation of niches. A specific mechanism for this is technological *add-on and hybridisation*. It means that new technologies in their early phase physically link up with established technologies, often to solve particular bottlenecks. Thus, old and new technology do not immediately compete head on, but form some sort of symbiosis. A second mechanism, is the break through of new technologies out of niches by riding along with the growth in particular markets (like the steam ships with the growth in passenger transport).

In the transition process Rotmans et al. (2001) distinguish four different transition phases:

A *predevelopment* phase of dynamic equilibrium where the status quo does not visibly change.

A *take-off* phase where the process of change gets under way because the state of the system begins to shift.

A *breakthrough or acceleration* phase where visible structural change takes place through an accumulation of socio-cultural, economic, ecological and institutional changes that react to each other. During the acceleration phase, there are collective learning processes, diffusion and embedding processes.

A *stabilization* phase where the speed of social change decreases and a new dynamic equilibrium is reached. (Rotmans et al. 2001:17)

An important characteristic in the transfer from the pre-development-phase to the take-off is that different ideas or perspectives from different fields cross-fertilize and converge into one, more or less consistent paradigm. Often there is a period of polarization between the existing and emergent paradigm. Parts of the regime will become susceptible and try to find ways to integrate the new

societal groups, suppliers, scientists, capital, banks etc. This makes the term ‘sociotechnical regime’ more appropriate referring to the semi-coherent set of rules by different social groups. It is a coevolutionary approach because elements in the technological regime develop together and interact with the development of new technologies. (Geels, 2002)

opportunities. This marks the take-off phase in which the dynamics within the dominant regime increasingly modulate with innovative experiments at the micro level. (van der Brugge & Rotmans, 2005: 7)

2.4.2 Transition management

Transitions are the result of the interplay of many unlike processes, several of which are beyond the scope of control, such as cultural change that can be considered a sort of autonomous process. Therefore they “cannot be managed in a controlling sense. What one *can* do, however, is influence the direction and speed of a transition and change the odds that a transition will occur”.(Kemp & Loorbach, 2003: 9). Environmental policies used in the past have proven insufficient in solving some key environmental problems. Prime reasons for a shift in policy towards engaging in transition management are: 1) The existence of barriers to system innovation, which have to do with uncertainty, the need for change at various levels and vested interests; as a result of this we are locked into trajectories driven by short-term benefits instead of longer-term optimality. 2) Because public policy is highly fragmented and oriented towards short term goals – transitions require the coordination of various policy fields: S&T policy, economic policy, innovation policy, environmental policy, transport policy and agricultural policy. (Kemp & Loorbach, 2003: 12). And further the acknowledgement that neither classical “planning nor a pure incentive-based approach will bring about system innovation (the latter approach will merely mine low cost solutions)” (Kemp & Loorbach, 2003: 23).

Transition management is “based on a different, more process-oriented philosophy that balances coherence with uncertainty and complexity” (Rotmans et al. 2001: 22). This policy concept for governmental or private actors’ policy, can be summarized in terms of the following characteristics:

- Long-term thinking (at least 25 years) as a framework for shaping short-term policy
- Thinking in terms of more than one domain (multi-domain) and different actors (multi-actor) at different scale levels (multi-level)
- A focus on learning and on a special learning philosophy (learning-by-doing and doing-by-learning)
- Trying to bring about system innovation alongside system improvement
- Keeping a large number of options option (wide playing field) instead of prematurely picking winners.

The aim of transition management is not so much the realization of a specific transition: it may be enough to improve existing systems, or the problems may turn out to be less severe than at first thought. “It is about working towards a transition that offers collective benefits in an open, exploratory manner.”(Rotmans et al. 2001: 22)

Central to the notion of transition management is that goals and visions change over time through the learning that takes place in a participatory process. This differs from so-called ‘blue-print’ thinking, which operates from a fixed notion of final goals and corresponding visions. Goals are often set in more flexible, semi-quantitative or qualitative objectives, whereas traditionally environmental policies are based on quantitative standards derived from studies of social risk. (Rotmans et al. 2001: 23) Better than setting specific end goals, is to take a leading principle, that is kept intentionally vague, like factor 20 or a complete sustainable energy sector. (van Vliet, 2005, college sheets). Or in the case of energy: cheap, safe, secure and environmental benign energy by 2050.

The starting point for transition management is that problems related to sustainability are unstructured and often ill defined. Since such problems do not have a single ‘owner and thus require collective action, a common definition of the problem at hand is necessary which enables developing shared goals. Transition management is therefore targeted at widely acknowledged problems (or ranging of problems surrounding a common theme like waste water management) requiring a response for which

no ready-made solution is (or will be) available. The solutions for these problems all have their own disadvantages, which in the short-terms lead to all kind of trade-offs: while solving the problem of emissions, costs may rise exorbitantly. The aim of transition management is to resolve the trade-offs on the base of transition goals that reflect social aspirations. (Kemp & Loorbach, 2003: 13)

Learning can be facilitated by stimulating experimentation on the niche level and subsequent evaluation and adaptations of policies (strategies, involved actors, progress etc.). (Kemp & Loorbach, 2003) Transition management is therefore also defined: “a reflexive technology policy approach on the changing of large socio-technical systems in the long term, through the facilitation of small initiatives (technological and market niches)”. The approach opposes those of technological forecasting and scenario studies as these are based on rather simplistic assumptions on technology dynamics. Many of such technology related anticipations are based on a linear model technology development, which leads to only a limited choice of either supply-push or market-pull policies. Instead, it is stressed that technology policies need to take into account the complexities and social processes involved in technology development. (van Vliet, 2002: 42/43)

Through the alternate use of two ‘sets of glasses’ - one to see the near future and one to see further ahead (which current policy with its much shorter time frame does not do) - it is able to stimulate options that are viable both for improving the existing system and to come to a more ideal innovative system that satisfies the transition objectives. The improvement of existing systems as a route towards sustainability is not rejected by TM; but it refrains from large investments in solutions that only fit into the current system, thereby causing a ‘lock-in’ situation. (Rotmans et al. 2001:24/25) Policy actions should therefore be evaluated against two types of criteria: 1) the immediate contribution to policy goals (for example in terms of eutrophication reduction, this would be the *content goal*), and 2) the contribution of the policies to the overall transition process (the *process goal*). Under the process goals also fall collective learning, maintaining variety and institutional change. (Kemp & Loorbach, 2003: 11)

Furthermore, its premise is that joining in with ongoing dynamics at the grassroots level – utilizing the opportunities of transformation already present - works better than forcing changes. (Rotmans et al. 2001: 24/25)

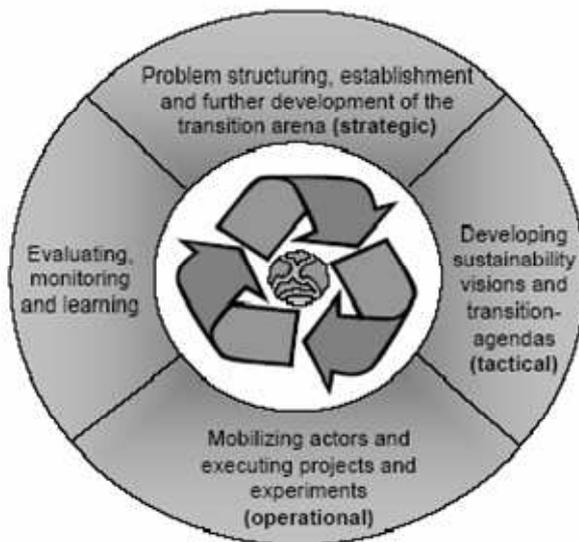
2.4.3 Role of government

Government can (and according to Rotmans, Kemp, Loorbach should) act as manager of the transition process. Not acting as the great commander, but guiding: mobilizing actors to build and participate in a network, encouraging the formulation of common visions, inspiring a collective learning process and facilitating experiments (niche management). Not just national government, especially local and regional governments, which have the practical responsibility for sanitation systems and are often more close to the other actors (building coops, citizens etc.) and can give space to more radical experiments for which no wider political mandate exists.

Niche management not only involves developing new partnerships, but also making changes in tax policies and in regulations (for example about the disconnection to the sewage and discounts on sewage taxes) so that real experimentation is possible.

The role of the government changes over the different stages of the transition process from facilitator/director to stimulator to controller and consolidator. In the pre-development phase being a catalyst for organizing and stimulating discussions and maintaining a wide playing field. In the take-off phase and acceleration phase, mobilizing actors in the direction of the transition objective and stimulating the learning process by drawing up an agenda, forming communal visions about what is desirable and possible; creating niches and anticipating the actor’s interests. In the stabilization phase, guidance is mainly orientated towards embedding, to prevent or contain backlashes and other negative effects. Rotmans et al. (2001) see guidance as most effective (but least visible) in the pre-development

Figure 2.1 Cycle of activities in transition management (Loorbach, 2004)



phase – where the promotion of variation is most important – and to a lesser extent in the take-off phase, making sure that the momentum is used well. Later on guiding becomes increasingly difficult, when the direction of developments is mainly determined by interacting reactions, causing autonomous dynamics and speeding up the process. The activities that should be undertaken iteratively in transition management are shown in figure 2.1.

Hence, transitions management is much more than implementing a strategic vision, it is a *joint search and learning process* directed at developing innovations and new arrangements that will start to reinforce each other.

The employment of diverse instruments and strategies does not only depend on the phase, but also on level of governance. A mix of top-down steering, network steering and self-steering instruments can be used, depending on the transition dynamics at hand. A challenge lies in attuning the measures taken on multi-levels so that they reinforce each other. The transition manager coordinates this multi-actor process at strategic, tactical and operational levels. (Rotmans et al, 2005)

It should always be kept in mind that the role of the government is limited: it has only limited influence over landscape factors (demography development, natural conditions, cultural values) and is constrained by existing structures and arrangements, such as the political structure in Europe. Finally socio-cultural factors influence the government's freedom to act. The acceptance and effectiveness of a unilateral and top-down manner of pushing through developments is declining in a time where social developments are increasingly the result of multi-actor processes. "Creating and maintaining support for transition objectives is therefore a perennial task" (Rotmans et al. 2001: 26)

2.4.4 Involved actors: the transition-arena

For my research I am going to look at the actors that could potentially make up what is mentioned in literature as "transition arena". "The transition-arena is a virtual arena, an open and dynamic network in which different perspectives, different agenda's are confronted, discussed and aligned where possible." (Kemp & Loorbach, 2003:16) Or: "A virtual arena or network, which provides room for long-term reflection and prolonged experimentation." (Kemp & Loorbach, 2005: 12)

In its first phase, "the transition-arena is a relatively small network [Loorbach & Rotmans, 2000 say 10 to 15 people] of innovators and strategic thinkers from different backgrounds that discusses the transition-problem integrally and outlines the transition goals. In this phase, it is important to come up with creative, inspiring and integrating goals and ideas. Further on in the process, the network will expand to include less strategically oriented actors (such as local authorities and people with practical knowledge of change) to develop transition paths and link these to existing (not only governmental) policies. Finally, short-term experiments and actions are derived from the goals and paths and more operationally oriented organizations and actors will be involved." (Kemp & Loorbach, 2003:16)

Very little is said on how and by whom these first people are selected, although van der Brugge *et al* (2005a: 17) do name the competencies they should have: "The water transition arena should consist of a small number of people, selected on specific competences like innovative capability, network ability, cross-domain and visionary thinking, creativity and relevant knowledge of the field. In modern water

management, knowledge from the social sciences is evenly important as hydrological or engineering knowledge. Furthermore, communication skills are very important when managing multi-stakeholder policy processes.”

Kemp and Loorbach (2005) also speak about the way such a transition arena should develop over time: “Through the use of different steering instruments, ranging from scenario’s studies, participatory methods and regular instruments such as pricing, subsidies and regulation, the initial arena has to evolve into a growing network based on a mutually defined direction for the future. Within such a transition-network, each actor has to redefine their own role, their competences and their *modus operandi* in interaction and co-production with the other actors. Through such a process of co-production and co-ordination, actors at different levels will be able to formulate joint goals and develop common strategies that involve societal uncertainties, power-relations, institutional barriers as well as ambitions, targets and desires. This way, a new structure of collective governance emerges whereby government is at the same time facilitator and one of the players.”

In its first phase the transition-arena is explicitly placed outside the arenas of day-to-day politics and policies but has to be supported by political or regime-powers (for example through the support of a minister, director etc). However, it should not be dictated by regime-powers, (Kemp & Loorbach, 2005: 13) since TM is said to “direct itself strongly to innovators and not the actors with large vested interests and is only consensual with regard to the long-term goals”. (Kemp & Loorbach, 2003: 16)

2.4.5 Comments to Transition Management theories

The theories on transition (management) are relatively new. Some interesting historical case studies have been done on transitions in the past (from coal to gas, from sailing ships to steam ships), but these transitions were either not intentionally managed or not managed with the idea of achieving sustainability. The theories therefore seem to form an appropriate analytical framework in some cases, but mostly in hindsight. Studies on still-ongoing transitions are scarce, but the two on the transition in Dutch water management by Verbrugge, Rotmans and Loorbach (2005) can be named. The theories have not (yet) proven to be useful for ex-ante analysis and forecasting.

A further comment is that a rather deterministic view is displayed on how change takes place. Even rather profound changes do not always take ages; change may be happening overnight and may even not be initiated from niches at the microlevel. Moreover, change might take place without it even being intended.

Determinism is also present because a theory on the role of agency seems missing. Grin et al. (2003) state there is little attention for the correlation/interaction between structure and actions. Little attention is also paid to the individual actors and their intentions. I will come back to the deterministic nature of Transition Management in the Discussion (7.3).

2.5 Evaluation of the conceptual framework

2.5.1 Discussing the choice for ANT and TM

The two theories that will together form my theoretical framework have been presented and their place in the tradition of technology studies is shown. It is now time to evaluate their utility and show how they will form the conceptual framework for analysing the (potential) transition arena in the network-bound sanitation system of the Netherlands.

The choice for ANT and TM is based on a careful selection of theories that show the importance of agency and choice in the change of network-bound LTS, without denying the influence of existing material and immaterial infrastructure. It is based on the acknowledgement that deterministic theories on technology development leave too little and the SCT theories too much agency to human actors, when it comes to network-bound LTS. Determinism presents the development of the current sewerage system as inevitable and so will be potential future changes. However, when we look back, we can see

that alternative lines of development could equally have been chosen, like the Liernur system (see 3.3.2). Also now, it is to a big extent a choice which new sanitation system we will get. On the other hand, we also clearly see the following of a technological trajectory (most money and research effort in companies and universities is directed towards optimisation of the current sewerage system) because of heuristics in the mind of engineers, but also due to the physical presence of infrastructure with huge sunken investments. This severely limits the agency of actors to choose for a radically different system. ANT and TM offer a more balanced view than the earlier theories.

The choice for a *combination* of ANT and TM is based on the idea that they can complement each other. TM is interesting as it looks specifically at the change of LTS, with their specific features, requiring the gelling of developments in different domains and on different levels. It offers specific terminology to analyse these type of changes. Furthermore, it pays ample attention to the attempts to steer or manage these changes and can therefore be interesting when one wants to generate policy recommendations. However, very little attention is paid to the actions and agency of individual actors. It therefore runs the risk of becoming rather deterministic or at least rigid.

This can be balanced by ANT, which gives more tools to analyse the network of *actors* as it pays ample attention to the interests, strategies and actions of individual actors and their interaction. ANT is directed at any type of project, not specifically at LTS as it argues that every technological change is a system change irrespective of its scale. Furthermore, it has little to say about policy implications. Adopting the AN-approach does, of course, not mean that I do not share any of the critique on this approach; it is much more a pragmatic choice to put on a 'set of glasses' that can structure my thinking, but can be put off and replaced by another set once they no longer produce good sight.

2.5.2 Conceptual set-up

In Chapter 5 the Actor-Network approach will be used to analyse and compare two different eco-sanitation projects: the DESAR project and the Nonolet project (which will be presented in the following chapters). I will shed light on the way they try to build up their *actor-networks* through *translation* and show examples of successful and flawed translation. Their success is judged by looking at the factors named in 2.3.3: the successful build-up of a *global* and *local* network, their establishment as an *obligatory point of passage* and their *momentum*. This results in recommendations to the innovators to improve their network-building abilities by changing their communication strategies.

In Chapter 6 I will fill in concepts from the theories on transition (management) for the case of sanitation development in the Netherlands. The multi-*level* framework will be used to analyse different developments taking place that could reduce or enhance the chances for a transition in the handling of toilet waste. We will look at the chances for *niche*-development, at the *phase* and at the *possibilities for steering* by different administrative bodies. The current networks around eco-sanitation are compared to the literature definition of a *transition arena*. This will lead to recommendations to the innovators and policy suggestions for the government.

Using the theory on transitions should be seen as an endeavour in finding out their practical use in analysing transitions ex-ante, instead of ex-post what is mainly done up till now. I do acknowledge the tension which exists between the use of transition theory and the focus on a specific set of techniques (named in chapter 1 as eco-sanitation), since transition theory is exactly about not formulating the outcome of a transition in fixed goals in terms of certain technologies, but rather in leading principles based on societal aspirations. However, like stated earlier I do not *a priori* assume that we are at the start of a transition in wastewater management, nor that alternative sanitation is (desired to) play a role in such a transition.

Chapter 3: Background on alternative sanitation

3.1 Introduction

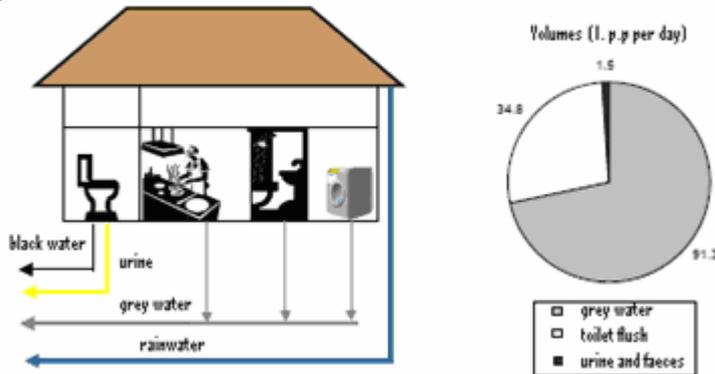
In this chapter I will introduce the different concepts of alternative sanitation, so as to give the reader some technical background to facilitate the reading of the subsequent empirical chapters. The current system of collection and treatment is characterized, the techniques of separate collection and treatment shortly explained and an overview is given of the (pilot) projects that take place in the Netherlands. In chapter 4 the people and organizations involved in alternative sanitation development will be presented.

3.2 Towards a new system

3.2.1 Characterizing the current system

In figure 3.1 we can see the different wastewater streams that are now all transported together by sewers to centralized wastewater treatment plants (WWTP), but differ considerably in concentration and composition: rainwater (although in some locations disconnected, on average 100 liter/person/day); relative mildly contaminated grey water coming from kitchen, washing machine and bath room (app. 90 l/person/day); toilet flush water (app. 35 l/person/day) and an average of one and half liter urine and faeces (together named black water).

Figure 3.1 Different household wastewater streams and their dimension Mels (2005)

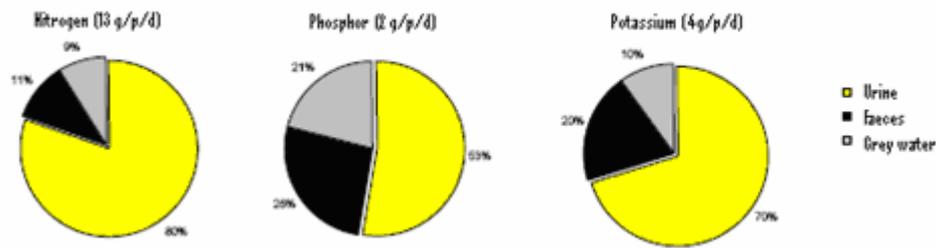


Treatment in the WWTP (Dutch: rwzi) is currently based on settling and aeration leading to breakdown by bacterially activated sludge, in some cases supported by chemical dosing (amongst others for dephosphating). Increasingly after-treatment takes place, mainly nitrogen removal and dephosphating. On average a quarter of the nutrients and an unknown diversity of medicine residues and hormones – which are not or only partly removed or broken down into unknown substances – are discharged by the effluent on the surface water. The majority of heavy metals bind to the sludge (preventing potential reuse), which is being composted or burned after dewatering and often processed into a building material.

3.2.2 A system based on source-orientation

Because of their different concentration and composition, separate treatment of grey and black water seems logical from a process technological view point. In figure 3.2 the mineral distribution is shown, which makes clear that urine carries the majority of the minerals in a very small volume. Therefore

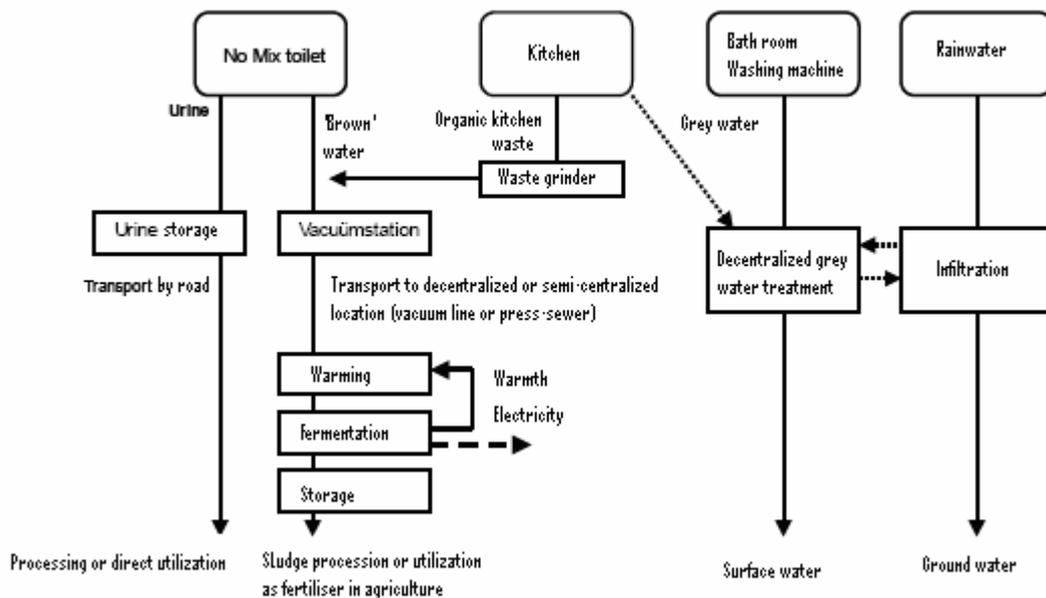
Figure 3.2 Distribution of minerals in urban wastewater Mels (2005)



urine or black water separation could help to reach the new EU Water Framework Directive¹³ (WFD) norms, especially in vulnerable areas where stricter effluent requirements will be imposed. It could also reduce the energy requirement of the WWTPs, since a lot of energy is now spent on aeration needed for ammonium removal. Also chemical dosing might be reduced. Medicine/hormones, which are nearly all present in the urine, would remain concentrated and therefore specific treatment will be less costly. The organic matter in black water can be used to produce biogas and black water or urine could (after treatment) potentially be utilized as a fertilizer.

In figure 3.3 a completely different sanitation system is shown, based on separation of all wastewater streams and subsequent separate treatment. It is actually a compilation of different concepts that will be introduced in the subsequent paragraphs.

Figure 3.3 'Total' eco-sanitation concept for all household wastewater streams (Mels, 2005)



¹³ The European Water Framework Directive (Dutch: Kaderrichtlijn Water) is meant as a framework for the protection of land surface water, transitional water, coast water and ground water. Its aim is to get the quality of European surface and ground water up to level ('to good status') by 2015. Its work fields are stipulated by river basins rather than by national borders. Provinces, water boards, municipalities and the ministry of V&W (traffic and water works) are all involved in implementation. V&W is responsible for setting the Dutch policy guidelines and norms. The Framework calls for a combined approach of emission limit values and quality standards for the receiving waters (which depend on the characterization of the water as 'natural', 'artificial' or 'strongly altered'). The precise consequences are still unknown, but it is expected that many WWTPs will have to take additional emission containing measures. On many places the quality will have to comply with the MTR (Dutch abbreviation for Maximum Allowable Risk) standards that are considerably lower than the current standards. The measures are expected to come into force by 2006/2007 and the effluents of the WWTPs should comply to the standards by 2015. (www.kaderrichtlijnwater.nl, January 2006 and Mels, 2005)

3.3 Separate treatment of black water or faeces

3.3.1 Dry toilets and composting

Minimalisation of flush water is seen as a precondition for coming to efficient treatment of black water or faeces, either through composting or anaerobic digestion. Therefore different toilets, like 'low flush' toilets, vacuum toilets, composting or dry toilets would have to be used.

Figure 3.4 Using the Nonolet toilet



Advantage of those toilets is that they save on drinking water, but the downside is that with such low flush water use gravitational wastewater transport is not possible (yet). (Mels, 2005) In dry toilets like the Nonolet toilets (developed by the 12 Ambachten) a compostable bag with the dried-in faeces has to be removed by the user. Urine is diverted to a storage tank which can be discharged on the sewage system or be led through a helophyte filter together with grey water. After every disposal the faeces are covered up by a few sheets of paper and pressed by a big 'press-papier', so forming an odourless, hygienic package. This can than be composted in the home garden or in a professional composting or digestion installation.¹⁴

In composting toilets, faecal matter (sometimes together with urine) is covered up with drying, structure and carbon providing material, like ash, straw, saw or rice dust and composted on the spot or elsewhere onsite. Composting toilets are not connected to the drinking water lines or to the sewage system. Decomposition to a humus-like product takes place by bacteria and other micro-organisms and a good composting process depends on a lot of critical factors like aeration, beneficial organisms, moisture content, temperature, carbon-to-nitrogen ratio, and pH. There are many different systems, both self-build and commercially; indoor toilets often with electrical fanning systems, outdoors often simple; and a composting container with single or multi chambers (continuous or batch process). (Bijleveld, 2003) It seems a promising option for rural areas where reuse of the compost can take place onsite and composting toilets are being used widely in a big number of countries, including the USA, Australia, Canada, Germany, South Africa and the Scandinavian countries. (Mels *et al*, 2005) In 1982, according to the Nordic Ministercouncil, there were 300.000 composting toilets in Scandinavia and the Tannum "municipality", near Goteborg, Sweden, has forbidden flush toilets from the year 2000 on.¹⁵ Also in Germany there are a few examples in which the collected toilet waste is composted on the level of house or building. The only Dutch example of composting toilets used indoors - in the Groene Dak project in Utrecht - became a failure: in spite of a lot of efforts from the users, the compost process turned out unmanageable and low-flush Gustavsberg-toilets (with a flow increaser allowing 2-4 litre flushes) were installed.

3.3.2 Vacuum toilets and anaerobic digestion

Where composting toilets ask a lot of effort from the users, vacuum toilets do not and are currently used in trains, on ships and in hospitals (on sections where treatment of patients with contrast liquids or other potentially environmentally dangerous substances takes place) to minimize the wastewater stream that needs to be stored or treated. In the context of the Dutch DESAR (Decentralized Sanitation and Reuse)¹⁶ research project the Wageningen University Environmental Technology Department is working on a concept in which vacuum toilets are proposed followed by anaerobic digestion. The toilets are 'flushed' by opening a valve and a small amount of water is used to clean the toilet (0.5 till 2 litres instead of 6 till 9 litres in a normal toilet). Vacuum or press-sewers needed for the transport do require energy to ensure underpressure. They are currently used in areas with a soft soil, like peat soils

¹⁴ www.de12ambachten.nl, March 2006

¹⁵ <http://www.deatech.com/natural/waste/toilet.html>, March 2006

¹⁶ <http://www.desar.nl>

and the system is based on flexible pipes with a diameter of 80 till 100 mm lying 80-100 cm underground. (Mels, 2005)

The collected toilet waste or faeces is digested in a reactor, which can either be placed on flat building, neighbourhood or semi-centralized scale. Whereas composting is done under aerobic conditions, anaerobic digestion is the biological degradation of organic material without oxygen. For anaerobic digestion the material need not be so dry as for composting and it is therefore suitable when faeces or combined toilet waste are very wet due to flush water addition (although the more water, the less efficient the process). Anaerobic digestion consists of three steps. The first step is the decomposition of organic material to usable-sized molecules like sugar. The second step is the conversion of decomposed matter to organic acids. And finally, the acids are converted to gasses. This is called biogas, which is principally composed of methane (CH₄) and carbon dioxide (CO₂). Biogas could be used as energy source. At the end biomass remains as sludge, which could be disposed, reused or incinerated.

The sludge from separate black water treatment contains lower heavy metal levels than WWTP's sludge, since metals from rain and grey water are not added. (Kujawa, 2005) This may facilitate utilization as a fertiliser, although as we will see in Chapter 4.5 there is very little demand for sludge in the Dutch context.

Organic kitchen waste could be added to the digester as well, by placing a grinder in the kitchen to produce more biogas; this might increase comfort for users and would render GFT-collection¹⁷ partly redundant (garden waste would still need to be collected). Use of such grinders – common in the USA - is currently prohibited due to the extra energy demand the addition of kitchen waste poses to WWTPs: when it is going to a separate reactor this would not be the case.

The only example of the use of 'vacuum' toilets in residential setting is historical: between 1870 and 1915 the Liernursystem based on pneumatic transport of human excreta that were used as fertiliser, functioned well in a few Dutch cities, in Luxembourg, Prague and St. Peterburg. It was considered hygienic by medics and before the introduction of artificial fertiliser even economically profitable. However large scale implementation did not take place and existing systems were broken down due to several reasons (van Zon, 1986). In 2006-2007 a pilot with black water separation will be realised in the context of the DESAR-project in Sneek in a new neighbourhood of 32 houses with vacuum toilets and digestion.

3. 4 Urine separation

3.4.1 No Mix toilets

Urine can be collected separately by using urine-diverting toilets or urinals. Urine-diverting or 'No Mix' toilets have a special drain for the separate collection at the front of the toilet. The urine is being stored temporarily in special tanks at building or neighbourhood level, after which it can be transported by truck or a special system to a central place for direct reuse or for procession. The 'brown water' (faeces plus flush water) can be transported to the normal sewerage, but the possibility exists to combine urine separation with separate faeces collection through the use of No Mix vacuum toilets. Several types of No Mix toilets exist that differ in design and functioning and in water use.

Figure 3.5 No Mix Toilet



Water use is lower than conventional toilets and as little water is added to the urine to realize concentrated storage. Because of the design of the toilet, men have to sit down when urinating. In Sweden the unwillingness of part of the

¹⁷ GFT stands for vegetable, fruit and garden waste

men to do so, was a reason for lowered separation efficiency. The installation of waterless urinals might mitigate this, although this would require more space.

In 2004 approximately 10.000 urine-diverting toilets were sold in Sweden (Mels, 2005A), in the Netherlands currently seven toilets are installed in pilots. In 2005, the Nieuwe Plassen pilot-project was started in Meppel. Three urine-diverting toilets were installed in a care facility for mentally handicapped and visitors centre, focusing on gaining experience with the installation, use and maintenance of the technical system and learning about the acceptance of users.

3.4.2 Advantages of urine separation

The installation of urine separation in new neighbourhoods or offices potentially renders WWTP's enlargement needless and brings down their energy requirement: the current energy requirement is 6 W per person, with a separation of 50-75% of the urine an energy *production* of approximately 1.5 W per person could be realised. Furthermore, if 75% of urine would be decoupled the MTR-requirements for N and P could be reached without further measures. Medicines and hormones which are nearly all present in the urine will remain concentrated; this is good for efficient treatment, but a point of attention for reuse. (Mels, 2005; Wilsenach & Loosdrecht, 2003)

3.4.3 Nutrient recovery from urine

When we take a look at the mineral distributions in figure 2, nutrient recovery from urine seems most promising, The human kidneys function like a system of reversed osmosis; hence urine is normally sterile and does not contain pathogens.

Mels (2005A) names as the main possibilities for reuse/recycling:

- Direct application of urine as fertilizer after storage in tanks (for six months) and transport per truck
- Processing according to process TU Delft (struvite precipitation and nitrogen components removal through CANON);
- Use as application liquid for composting;
- Use in industrial wastewater treatment (Mels 2005A includes a case on application in the paper industry of which the tentative conclusion is that it has potential if concentrated by factor 10-20)

In Chapter 4.6 the ideas of the actors on the feasibility of several options are presented. What follows now is a short explanation of the second option named above.

When talking about nutrient recovery, it is best to make a distinction between the case of nitrogen and the case of phosphate. Phosphate is a finite resource, sustainability goals thus require recycling and the demand for recycled phosphate will rise in the future (although as we will see in 4.6 there might be more suitable sources for recovery than human urine). For nitrogen/ammonium (not a finite resource) sustainability can be defined in terms of energy or exergy requirements: only if ammonia *recovery* requires less energy than nitrogen *removal* + the energy required for industrial ammonium *production* via the Haber-Bosch process, it is more sustainable. It depends on the techniques used for removal and recovery which proves most sustainable: Maurer et al. (2003) (in: Wilsenach et al, 2003) show that the energy required for indirect recovery (Sharon/Annamox¹⁸ and production via the Haber/Bosch processes) is 60% higher than energy required for direct recovery via thermal volume reduction of urine, but 60% lower than for recovery via air stripping. In current prices recovery is always more expensive than efficient removal.

Both removal and recovery techniques are more efficient in the use of energy and chemical dosing when applied to urine – with its high mineral concentrations (even compared to some industrial waste water streams) – than to the total waste water stream. However, potential energy gains can easily be

¹⁸ In the Sharon process partial oxidation takes place and in the Annamox process autotrophic denitrification. They are combined in the CANON process.

offset, if one counts the extra energy costs of truck transport of the separated urine. Local or de-central treatment of urine seems to be a solution. The treated liquid could drain through existing sewers and trucks could remove recovered minerals. (Wilsenach & Loosdrecht, 2001)

For phosphate recovery two methods are most frequently named. Calcium phosphate can be recovered from waste water with complex and expensive processes, taking place at some conventional WWTPs in the Netherlands. Recovered calcium phosphate is virtually indistinguishable from mined apatite, which is used in the production of commercial phosphorus or phosphoric acid. Struvite (magnesium-ammonium-phosphate $MgNH_4PO_4 \cdot 6H_2O$ or potassium-ammonium-phosphate $KMgPO_4 \cdot 6H_2O$) is a form of kidney stone and its precipitation is a simple process in comparison to calcium phosphate precipitation. It can be retrieved from urine by the addition of magnesium, but also takes place spontaneously in water plants causing clogging of the pipes. Controlled struvite precipitation from side streams could be economically beneficial when compared to more conventional chemical phosphate removal, according to the STOWA report by Wilsenach & Loosdrecht (2001). They also estimate the price of apatite to be only around 40euro/ton. They estimate that the value of struvite could be as high as 300euro/ton and could be used directly as fertilizer or in combination with other fertilizers. The production cost of struvite is equal to its value, but in the case of apatite the production cost is higher and the potential value lower than struvite.

Lind et al (1999) investigated the possibility of recovering ammonia from urine by a combination of struvite crystallization and ammonia adsorption by mixing the remaining urine with natural zeolites (especially clinoptilolite): up to 80% of the total ammonia load was removed by adsorption. This combination of techniques could be useful for recovering both nitrogen-ammonia and phosphorus from urine. (Wilsenach & Loosdrecht, 2001).

As we will also see in paragraph 4.5.3 there is a lot of discussion on the agronomical value of struvite. Burns *et al.* (2003) states that although it is generally known that struvite can work as a good slow release fertiliser, its nutritional value for different crops is unknown. The N:P:K ratio in struvite available to plants still has to be researched. Trials on wheat showed that a mixture of untreated struvite/zeolite from urine can be a good slow-releasing P-fertiliser comparable to diphosphate (Ganrot 2005). The same results were obtained by using different (both synthetic and recovered) struvites on perennial ryegrass by Johnston & Richards (2003). For nitrogen struvite is not such a good artificial fertilizer substitute due to its slow-release.

3.5 Grey water treatment

Another important component of eco-sanitation is the disconnection and local treatment of grey water. Since my research is focused on black water, I will only spend a few words on grey water treatment here, to complete the picture. This takes place in a few neighbourhoods in the Netherlands and is mostly done by the use of helophyte filters. A helophyte filter consists of a watertight foil reservoir filled with cane plants and filter substrate. In the filter biological, physical and chemical processes take place by which waste materials are being degraded and converted. The wastewater is brought into the filter intermittently (with a frequency of 2-4 times a day) by an influent pump. Generally, effluent quality can comply with the legal discharge requirements and the effluent can be discharged on local surface water: to combat dehydration and create an attractive urban design. Helophyte filters do take a lot of place (2-4 m² per inhabitant), but when well integrated in the urban design hardly imply extra costs. Also other aerated systems for grey water treatment could be used like bio-rotators or membrane bioreactors and even anaerobic systems might be effective. (Mels, 2005)

3.6 Overview

In this chapter the main concepts of alternative sanitation have been treated, being:

- Separate black water collection and treatment by:

- Dry and composting toilets followed by composting
- Vacuum toilets followed by anaerobic digestion
- Separate urine collection by No Mix toilets
- Separate grey water treatment

In table 3.6¹⁹ an overview can be found of the small number of projects using these concepts in the Netherlands.

Table 3.6 Source-separated sanitation in urban areas in the Netherlands (April 2005, adapted from Mels 2005)

Name and year of installation	Type					
	Local grey water treatment	Black water, compost toilet	Black water, Gustavstoliet	Black water, vacuum toilet	No mix toilet	Local rainwater infiltration
Historical						
Liernurssystem Leiden, Dordrecht and Amsterdam (1870-1915)				X		
Current projects						
Groene Dak, Utrecht (1993)	X	X	X			X
Drielanden, Groningen (1995-1997)	X					X
Polderdrift, Arnhem (1996)	X					X
Lanxmeer, Culemborg (1999-2003)	X		X			X
Schutterstraat 1, Delft (1995)	X	X			X	X
Waterspin Den Haag (1996)	X					X
Rijkswaterstaat Terneuzen (2000)	X					X
Watermuseum Arnhem (2003)	X				X	X ¹
Hoofdkantoor Hoogheemraadschap Rijnland (2004)	X				X	X ¹
Projects in preparation						
Ecopark, Emmeloord (2003-2005)	X					X
Sneek (2006-2007)	X			X		X
Meppel (2005)					X	

¹ In the Watermuseum rainwater is used in several elements of the exhibition

¹⁹ For an elaborate overview of source-oriented sanitation projects in the Netherlands, Sweden and Germany I refer to Mels *et al.* (2005)

Chapter 4 Actors, problem perception and views on alternatives

4.1 Introduction

Having developed a conceptual framework on actor-networks and transitions and having painted the background of techniques and projects, the décor is ready for the actors to enter the stage of my research. In the next two chapters I will present my analysis of the findings on the actors that make up what we have coined the ‘potential transition arena’. This chapter will start with presenting the actors and showing their current involvement in alternative sanitation development (4.2). The given list is not meant to be exhaustive in mentioning the organisations that are involved in sewerage, sanitation, wastewater management or organic waste production and utilization in the Netherlands, but I believe that the relevant actors for my research are included. Relevant for this research are: the main actors involved in the development of new sanitation concepts (‘the innovators’ which can be found in universities, NGO’s, consultancies and private firms); the actors forming the current policy community on sanitation and wastewater management made up by the administrative bodies and their related knowledge and research institutes; and lastly the actors that might have to be involved when a transition is sought to be effectuated, where I focused on solid waste processors and nutrient/ organic matter recyclers. As was explained in Chapter 1, this last group so far received very little attention in research.

Secondly, I will present the actors’ perception of the current situation and whether they see a need for change towards source-separation of toilet waste (4.3). Their views on the different alternatives – urine separation, anaerobic digestion and composting – are presented (4.4). A special paragraph is dedicated to their views on nutrient and organic matter recovery from toilet waste (4.5).

In figure 4.1 the different actors are pictured: the coloured actors are involved in the development of new sanitation concepts and the DESAR project is shown. In Chapter 5, the figure will be elaborated further, showing contacts and cooperation between the different actors and the networks that can be distinguished.

4.2 Presentation of the relevant actors in the current network and the innovation network around toilet waste

In the References a table can be found with the names of the interviewed and their organisation.

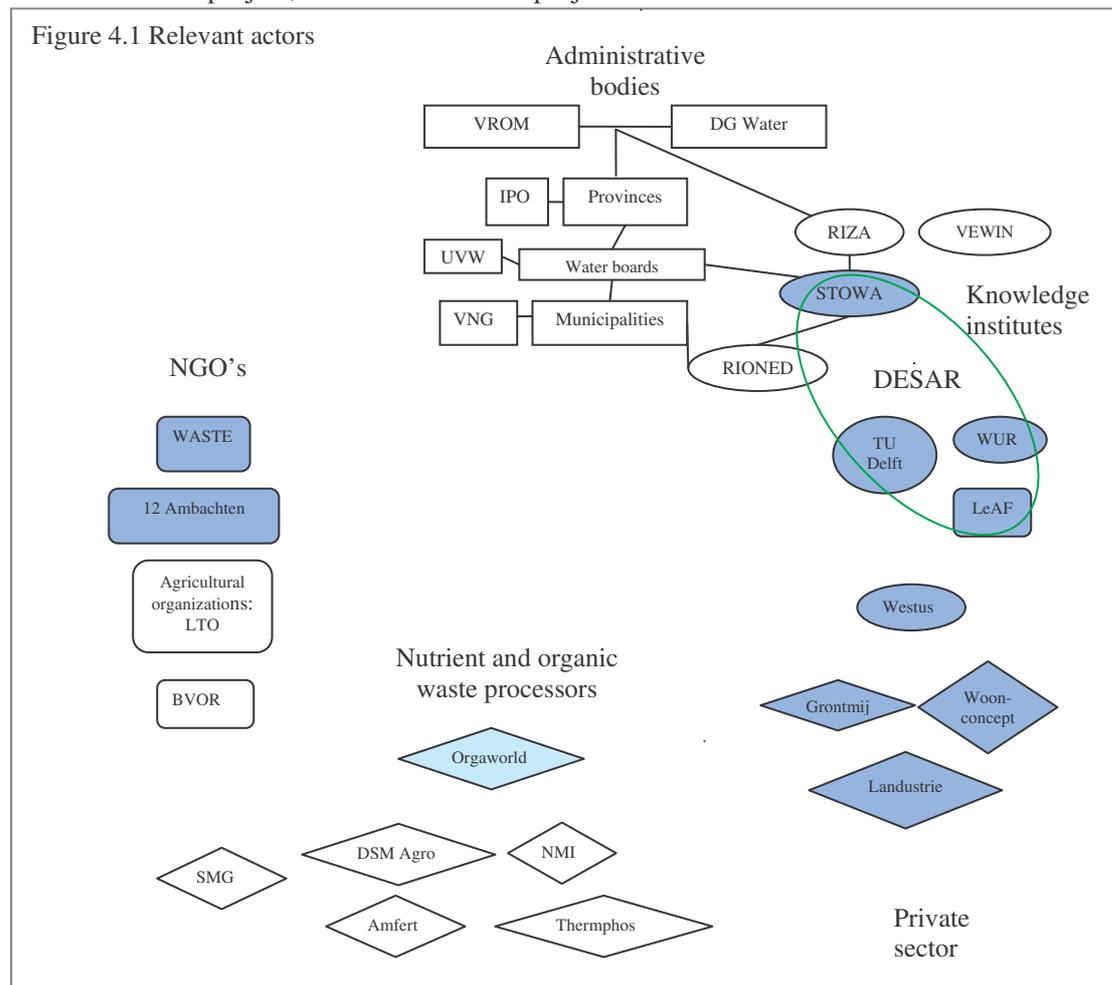
4.2.1 Administrative bodies

The *EU* has a rather big influence on water quality management. The cooperation between the European countries on this issue led to the adoption of the Water Framework Directive (WFD), which will probably require huge investments from the district water boards in the coming years to comply with the more stringent effluent norms. The EU has prohibited the untreated discharge of wastewater or sewage and is supporting, especially in the new member states, the layout of sewerage systems and building of treatment plants by granting subsidies. No direct involvement in eco-sanitation development can be observed.

VROM (Department of Housing, Spatial planning and the Environment) is the administrative body with responsibility for national policy and regulation on sanitation and sewerage. Involvement in development of ‘new’ sanitation: only indirect, by granting subsidy through EET-project until 2006.

DG Water (falling under the Department of Traffic and Waterworks) works on water quantity and quality, setting national emission targets and controlling the water boards in their tasks to achieve these targets. No direct involvement.

Provinces are coordinating efforts on water quantity and quality management on a regional level. They are the ones that can grant municipalities an exemption of the obligation of connecting a premise to the sewage system. Involvement: province of Drenthe involved in failed Stroomdal project and in Nieuwe Plassen-project, Friesland in Sneek-project.



Water Boards (Dutch: Waterschappen) are the administrative bodies with the responsibility for the operational management of water quantity and quality in their area. One of their tasks is the treatment of urban wastewater and the wastewater treatment plants (WWTP, Dutch: RWZI) fall under their auspices.

Municipalities bare the task of collecting and transporting household wastewater and rainwater.

Current policy of all of the administrative bodies is outlaying or maintaining the current sewage system and centralized mainly aerobic treatment, but with the disconnection of rainwater. The revision of the policy towards 'new' sanitation in the next decade is not considered seriously. The engagement in pilot projects of the interviewed is an exception to the rule: Waterschap Reest & Wieden and municipality Meppel were participating in the Nieuwe Plassen pilot-project in Meppel. Nonetheless after the Nieuw Plassen-project initiation, more water boards have shown interest in innovation towards collection of wastewater in separate streams. Waterschap Hunze & Aa's, Hoogheemraadschap Rijnland and Waterschap Reest & Wieden are planning pilots in their area.

4.2.2 Knowledge and research institutes related to administrative bodies

RIZA is the national knowledge institute for integrated fresh water treatment and wastewater, working in the field of policy, inspection and execution of national policy, with an advice function towards the

administrative bodies. There is no other involvement, except for the participation of RIZA in a commission that is considering the subsidy applications from STOWA, and thus also approving the subsidies for DESAR and NP.

STOWA is the association for applied water research, functioning as an 'estate agent' between demand and supply in water research. Financed by Rijkswaterstaat, the provinces and the water boards. *STOWA* is one of the main contributors to the DESAR research and the NP-pilot. B. Palsma (interviewed in this research) is through *STOWA* trying to coordinate the different research and initiatives on separate sanitation. *STOWA* also set up an umbrella group (the ONNS-koepelgroep) for the separate collection and treatment of wastewater streams and a much smaller group (B. Palsma, G. Zeeman, K. Zagt) focusing on strategies for the development, influenced by the ideas of transition management.

RIONED is the knowledge institute for sewerage branch, financed by municipalities, water boards and sewerage companies. They were present at a few symposia, H. Gastkemper (whom I interviewed) gave speeches, but rather than giving active support to the development of alternatives, they follow it passively.

VEWIN is the branch organisation of the Dutch drinking water companies (which are in public hands). In 2003 they called for attention to the future threat that medicine residues can pose to drinking water production and recommended the separate collection of toilet waste from hospitals and care facilities. They were partner to the NP-project.

4.2.3 Independent research institutes

Wageningen University and Research Centre (WUR), Environmental Technology Department is working on anaerobic digestion of a.o. wastewater since the 1970's. G. Zeeman (whom I interviewed) is project leader of the DESAR-project: a research project on decentralized sanitation and reuse, financed by EET and *STOWA*. A. Mels is also strongly involved in this project. In the context of DESAR two pilot-projects were tried to be set up in Wageningen and Emmen, both failed, but in Sneek a pilot will start in 2006: in thirty-two new houses black water separation will be employed using vacuum toilets and subsequent anaerobic digestion of the toilet waste (and organic kitchen waste from one household) will take place in an UASB-reactor. Closely linked to this department is the 'not for profit' firm Lettinga Associates Foundation (LeAF), which is promoting the implementation of anaerobic technology and is also partner to the DESAR project.

Environmental Policy Group of WUR is also involved in the DESAR project, mainly through the social and policy analyses by D. Hegger and B. van Vliet on eco-sanitation and other innovations in the water chain.

Technical University Delft is involved in the DESAR project. Dutch research on separate urine collection, treatment and mineral recovery is almost exclusively done by W. Wilsenach and M. Loosdrecht.

Also the University of Twente is a (minor) partner in the DESAR project, but was not analysed.

Wetsus, Centre for Sustainable Water Technology, is a research institute in which TU Delft, WUR and University of Twente work together with companies. One of the projects they run is on decentralized wastewater treatment.

4.2.4 Consultancies

Grontmij is working on the implementation of urine separation in the NL and B. Swart (whom I interviewed) initiated the Nieuwe Plassen-project in Meppel. Not part of DESAR, but working in close cooperation with its participants.

DHV worked together with Grontmij on proposals for an emission-free water chain for the new to build Meerstad, an assignment from district water board Hunze & Aa's..

Van Hall is expert on IBA's and (minor) partner to the DESAR-project.

4.2.5 Commercial firms for wastewater collection and treatment technology

Roediger, German company providing vacuum toilets, vacuum sewerage, no-mix technologies and advertises explicitly with their Ecosan technologies. Their toilets are mainly used in the Dutch and German pilots.

Paques, Dutch company specialised in anaerobic water treatment, building biological purification systems for water and gas.

Landustrie, they participate in the Sneek DESAR-pilot and have started another pilot project on decentralized, though not source-separated, wastewater treatment in Sneek. But their main expertise is 'conventional' wastewater treatment.

4.2.6 Organic waste processors

In the Netherlands organic waste processors can be divided in two groups: the 'green' composters, handling organic waste from parks, forests and other public or private green in mostly open-air installations and the 'general' composters/ digesters handling organic waste from households, offices, shops, service and agricultural sector and auction waste. In 2003 there were 21 indoor composting installations and only two digestion installations in the Netherlands. (Willems, 2005)

In my research I spoke to the *BVOR*, the branche organization for green composters. None of their members is involved in eco-sanitation. J. Smout from the BVOR participated in a WASTE discussion platform on the issue, but only on personal title.

From the 'general' group, I spoke to Orgaworld BV, composting company and the only organic waste digester of the Netherlands. Their involvement: a successful try-out of processing the dried-in faeces from the Nonolet-toilets developed by 12 Ambachten and successful trials on diaper processing.

4.2.7 Nutrient and organic matter recyclers

From publications and talks to WASTE and later to Thermphos International, the following actors were identified as the main parties with a potential interest in the recycling of nutrients from human toilet waste:

The *phosphate industry*, producing phosphates and its derivatives for a grand range of application. Interviewed was the only Dutch company in this category, Thermphos International BV. They are involved in WETSUS and recycle calcium phosphate from the purification sludge of the rwzi's (this takes place on small scale in the Netherlands). They also did a trial on ammonium-struvite use which had a negative outcome. They do use a few hundred tons of potassium-struvite from calf slurry each year.

The *artificial fertilizer industry*, of which I interviewed the biggest Dutch players, Amfert BV and DSM Agro and Zuid-Chemie. Amfert is recycling calcium phosphate from sewage sludge and did a trial on struvite reuse from calf slurry with positive outcome. No connection to the sanitation innovation network(s). DSM Agro: no involvement. Zuid-Chemie: no-involvement.

Agricultural sector could utilize the raw material (urine and/or faeces) or compost, struvite or other products in which human manure would be processed. The sector can be split up in food and non-food agriculture. Current involvement: only the utilization of a very small amount of compost made from digested organic kitchen waste mixed with dried-in faeces from Nonolet-toilets through Orgaworld. Some information on this group was obtained through the composters, through literature and through two earlier interviews from WASTE (Geurts, 2003) with Bureau Bevordering Mestafzet and Centrum voor Landbouw en Milieu. Interviews took place with the Nutrient Magement Institute and Z-LTO: both organisations are currently not involved. Furthermore, The Stichting Mestverwerking Gelderland was interviewed, who produce a few hundred tons of struvite per year out of calf slurry. They share their knowledge on struvite production with the DESAR-project.

The *garden sector* is currently not involved in alternative sanitation.

4.2.8 NGO's

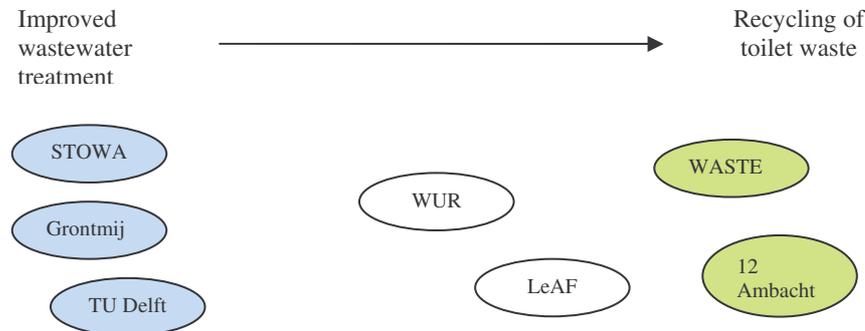
WASTE is a NGO advising on sustainable improvement in the urban environment in the fields of waste management, sanitation, community based environmental improvement and small- and medium scale enterprise development. Their main work fields are in developing countries, but they also have some projects in the Netherlands, amongst which is the stimulation of 'ecosanitation'. They have conducted research on the possibilities and try to get parties (municipalities, solid waste sector) interested.

De 12 Ambachten is a 'centre for ecological techniques', developing and promoting simple water and energy saving techniques, self-build stoves, helophyte filters and the dry Non-Oilet toilet.

4.3 Problem definition: need for change to source-separation?

The 'innovators' (those involved in the development of alternative sanitation concepts) all name similar disadvantages of the current sewerage system. However they prioritize the problems differently as can be seen in figure 4.2. According to Palsma (STOWA), Swart (Grontmij), Loosdrecht (TU Delft), the main advantage of alternative sanitation lies in a more effective and more cost-efficient purification of wastewater, as the main problem of the current system is the dilution of contaminants (hormone disruptors and medicine residues) and nutrients. Zeeman (WUR/LeAF) also names dilution as the main problem, but within LeAF and the original DESAR plan emphasis is also placed on the reuse of nutrients, energy and of the wastewater itself. For *WASTE* and the 12 Ambachten the recovery of nutrients and organic matter for agriculture is an – and for the 12 ambachten *the* - essential feature of eco-sanitation.

Figure 4.2 Advantage of alternative sanitation emphasized by the actors



Energy saving is also named as an advantage of alternative sanitation. In the latest report for STOWA, Wilsenach *et al.* (2005) even state that for urine separation: "the main advantage is not the production of better effluent quality, for there are processes capable of producing very good effluent quality. The main advantage of integrated wastewater and urine treatment is the production of very good effluent quality (2 – 3gN/m³) with a substantial saving in resources and even net production of primary energy". For anaerobic digestion however, Zeeman (WUR/LeAF) states: "Energy production of digestion is only very small and is more an extra than a big chance. The benefit must be sought in improving effluent quality and nutrient reuse."

The water board and the municipality that were involved in the 'Nieuwe Plassen'-project, repeat the advantages of a new system as communicated to them by the project initiators Grontmij and STOWA: improved water treatment and the opportunities this would give to live up to the new European WFD norms or postpone the enlargement of WWTPs. However, the municipalities did not see any direct advantage for themselves; on the contrary they expect change to bring them high costs.

Although Gastkemper (RIONED) acknowledges that with regard to energy efficiency and nutrient recovery the current system is not optimal, he states that it is not at all certain whether this justifies a radical break away from this system towards source-separation. He misses a clear necessity, feels that much can be done with end-of-pipe technology. Furthermore, he states that among his supporters (municipalities, water boards, sewerage branch) there is certainly no sense of urgency for these changes. Vermij (RIZA) explains that the same is true for his organization and the national government: “We do not feel that what is at stake can be defined a ‘major environmental problem’ and therefore there is no urgent need for this radical change. We are talking about sustainability steps: this means we have to weigh the advantages against the - probably huge - costs. Until there is much more clarity on these benefits and costs, no action will be undertaken.” Martijnse: “We are open to alternatives; other systems – provided that they have the same comfort level – could have been just as fine as the current sewerage system. However, this entire infrastructure is already present: will the benefits really outweigh the enormous costs of change?”

The hygiene, reduction of nuisance and environmental contamination and the high consumer/citizen comfort of the current system are hailed by most as hallmarks of the current system. These positive sides tend to be stressed more by Gastkemper (RIONED), Vermij (RIZA) and Martijnse (VROM) and less by those in the innovation network(s), although an exception can be made for Loosdrecht (TU Delft). He states that if he could redesign the wastewater systems it would look rather similar to the current system with collective collection and treatment on large scale as this is rather cheap and efficient. And “collection of waste by water is also much more efficient than by trucks.” Gastkemper, Vermij (RIZA) and Loosdrecht also seem the ones most firmly believing in substantial opportunities for improvement through the optimisation of processes and end-of-pipe techniques like in sludge processing, recovering nutrients and improving the Annamox²⁰ process. Gastkemper finds separation at source a good principle, but it should be dealt with in a pragmatic way, not as an ultimate goal, but a possible means to serving societal goals of environmental improvement, public health or economy; and applied only if not conflicting with public health and comfort. Beside he urges people not to forget the continuing importance of sewerage for rainwater transport: “rainwater is determining the manner of sewerage, the size of the tubes and the problems. The sewerage system will therefore remain necessary also if we disconnect the grey or black water.”

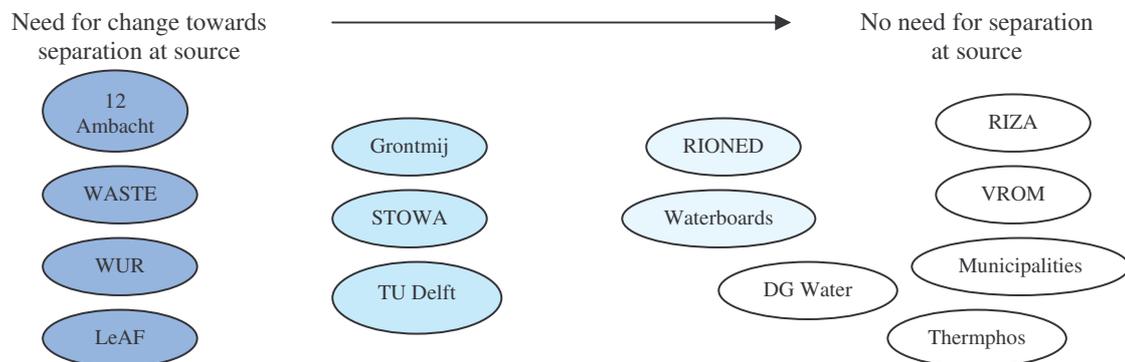
But also Palsma (STOWA) and Swart (Grontmij) are anxious to state that they are only pragmatic supporters of source separation. As Swart puts it: “As soon as the smart guy stands up, that finds the solution for the cost-efficient and effective nutrient, medicine and hormone removal end-of-pipe, we immediately stop our experiments.” Palsma: “I do not have the firm belief that option A or B should be implemented per se. I only have one belief; that is if you do not try out things, because of fear that they do not work or are not accepted by the people, you will never find out what is best. Of course, you have to look beforehand at whether there is a chance for it to work, but although I have no idea whether all of the Netherlands will be separating its urine in 20 years, the only way to progress is to try-out things.”

On the contrary, Zeeman (WUR/LeAF) fully acknowledges the need for a transition towards a source-separated system: “Good nutrient removal always costs a lot of energy in the current system, the new technology is very expensive and not yet in place. And it does not solve the medicine residue problem: although we do not yet know how to take out these medicine residues, of course it will be easier if you have them concentrated in seven rather than in two hundred litres.” She thereby contradicts Schipper (Thermphos) who is interested in the recovery of more phosphate for recycling, but feels this can be realized just as well in the current centralized system: “In the current situation a 70-80% phosphate recovery is possible. In a decentralized system everyone gets stuck with a few hundred kilos struvite here and there, which they can hardly dry....”

²⁰ A bacterial process of autotrophic denitrification to remove ammonium.

The different positions are summarized in figure 4.3.

Figure 4.3 Perceived need for source-separation of black water amongst actors



Even though the need of a transition towards source-separation in the Netherlands is fiercely debated, experimentation is generally regarded useful. Martijnse (VROM): “Please, continue experimenting, something interesting might come out, if not for direct application in the Netherlands, then still knowledge is created that maybe beneficial in other countries.” And Loosdrecht (TU Delft): “It is good to keep paying attention to decentralised treatment. Interesting developments take place, which keep everyone in the wastewater sector on their toes.”

4.4 The alternatives

4.4.1 Uncertainty

All of the interviewed stress we are in a very early stage of developments of new sanitation systems, where uncertainty is still paramount. That the technological principle of anaerobic digestion and urine separation function and that these techniques offer potential benefits for wastewater treatment in comparison with conventional systems seems clear. But how big the benefits are and how big the costs; whether problems occur during long-term operation and management/maintenance; whether the technologies and the change in behaviour they presuppose will be accepted by society; what can best be done with the source-separated urine or faeces etc. is still a discussion which can continue in many directions. Zeeman (WUR/LeAF): “The technologies are in a stage of development in which they are workable, but not yet optimal. No winning technology could be picked. There is no answer to the question yet which system of collection and treatment will be best in each specific situation.”

It is not even clear whether ‘decentralized’ is always the right choice. Zeeman (WUR/LeAF) admits that the use of the term in the title of the DESAR-project is a bit misleading: “If I could have renamed the project, I would leave out the decentralized, as my preference for decentralized is not so clear anymore. Decentralized is a very relative term anyhow: do you talk about one apartment block, a neighbourhood or a municipality. I would rather stress the idea of ‘separation at source’; decentralization can then be a means.”

4.4.2 Anaerobic digestion and urine separation

When asked for the desirability of different alternatives, the innovators naturally show some preference for the technique they themselves are working on. Thus Zeeman (WUR/LeAF), who works on anaerobic digestion: “I would say that it is now clear that at least black water should be separated from the rest of the wastewater. Anaerobic digestion is needed, at least as the first step of purification, to reduce the problem of hormone and medicine residues and to save energy. Whether urine diversion is desirable is not yet clear: disadvantage would be having to include yet another track, the advantage

is that you keep clean urine. I think much will depend on the medicine problematic. Furthermore, if you separate urine you will probably make use of chemical methods for nutrient precipitation, so no biological treatment of nutrients is done, this can be a disadvantage as well. The newest studies by Wilsenach [2005] show that the energy demand for removal of nitrogen might be less than for recovery. A Phd-student is currently starting a research on comparing the tracks with or without urine separation: which route leads to better handling of nutrients and medicine/hormone residues.”

But Loosdrecht (TU Delft, in: *HtweeO*, no 11, 2005), who works on urine separation states: “Separation of wastewater at source can offer advantages, but should also be evaluated in a wider context. Separate collection of faeces will probably cost more energy than it will save at the WWTP. For urine this is different. The nitrogen concentration in urine is so high and the total daily amount of urine per person is so low (around 1 liter) that decentralized collection and (pre)treatment can be rewarding. In urine there is enough CZV to remove half of the nutrients; with Anammox all of it can be removed. After treatment the urine can simply be led back into the sewer. This will be especially rewarding in apartment buildings, but will still be more expensive than the current system. This is the case for all decentralised treatment, but economic arguments are not the only ones that count in an integrated view.”

And Leeftang (12 Ambachten) who invented the dry Nonolet toilets, remarks about urine separation: “Good idea, Orgaworld is ready to take in urine to digest. But then you would still need to invent a smart system to get it collected, transported etc., which I think will imply a lot of trouble. I would say just keep transporting the urine through the sewer, because the problem is much more the amount of flushing water. By not using flush water, like in the Nonolet toilets, you discharge 35% less wastewater per household – this would render the installation of a separate rainwater discharge needless, and this would save not millions, but billions of euros!”. Leeftang explains that the 12 Ambachten have changed their radical anti-sewer attitude. “The sewers can be maintained for urine and grey water and then ideally treatment would take place in smaller installations, like helophyte filters. Helophyte filters would completely solve the problem of medicine and hormone residues, as they will be degraded.²¹ Thorough research on grey water reuse in horticulture has shown that bacteria and fungi are completely degraded too.”

According to Swart, Grontmij’s choice to focus on urine diversion does not mean that they see this as the most promising or best technology. “Others were already working on other technologies. Albeit... anaerobic digestion could only be a small part of the solution, because you do generate energy, but you keep an end stream with a lot of nutrients, heavy metals and medicine/hormone residues. Urine diversion would solve these problems. It seems very logical to me: nowadays 75% nitrogen removal is considered a good result, while urine is carrying 85% of all nitrogen, separating that would mean a big gain. And it will of course be cheaper to direct advanced techniques for medicine and hormone removal to such a small volume than to the whole stream.”

It seems that urine diverting toilets could be built into existing infrastructure relatively easy, when compared to separate black water treatment. (Mels, 2005; Wilsenach & Loosdrecht) However, according to Swart (Grontmij) this is not necessarily the case: “A lot depends on what can be done with the urine or faeces. If in a neighbourhood there is already a biomass digester, it might be easier to combine this with a faeces digester.” That leads him to a conviction he shares with Palsma (STOWA) : “We will go to a more diverse system of sanitation, in which different systems co-exist: in urban centres sewerage will remain for a long time, in more isolated rural areas decentralized wastewater treatment will prevail; where there is a local market for nutrients, recycling nutrients coming from urine or faeces will be an option; where biomass is already digested to generate energy, this can be combined with faeces digestion”.

²¹ Whether this can be scientifically underpinned has not been investigated during this research.

Gastkemper (RIONED) who is himself not involved in the development of one of the techniques, sees equal possibilities for urine separation and digestion or composting after collection by vacuum tubes, although he keeps stressing that in the Netherlands only limited interest for new sanitation techniques exists. For the moment though, he advises against applying urine separation in private residences: “I am not principally against that, but why start by installing in private residences, where the costs and the risk of wrong use or non-acceptance are highest, while the benefits will be lowest as the quantities will be small?” For now he sees much more in the use of urine that is already collected separately like in the urinals that are in use at festivals and could be obtained for free. Furthermore he feels, separate collection of the faeces with subsequent digestion or composting, could be interesting for energy recovery; “I know it is not such a big quantity, but it could be interesting anyway, especially when you make a smart combination with processing of organic kitchen waste at the same time like they are now doing in Culemborg for the EVA-Lanxmeer project, where CORE is recovering gas²²”.

Martijnse (VROM) does not see anaerobic digestion as a good option for the Netherlands; it is too cold and too wet “But at Wageningen University they just go on with their research. Well, I am sure a lot of knowledge is generated that can be useful in developing or warmer countries.” “Besides I would not want such a digester in my garden.”

The majority of the interviewed stated that they lack the knowledge to judge which of the techniques is most promising. Kool (Waterschap Reest&Wieden): “Participation in a pilot on urine separation was offered to us, it does not mean we see it as most promising. I am little informed about decentralised digestion of black water, but I think if that was offered, we would have said yes too.”

4.4.3 Composting

Amongst the interviewed there is no enthusiasm for true compost toilets, in which the toilet waste is composted under the toilet. In other countries outdoor compost-toilets are sometimes common in the rural areas. But as could be seen in the Groene Dak project, in an urban setting an indoor composting process is very hard to manage, even when citizens are willing to put in a lot of effort. (Mels *et al.*, 2005)

Collection of the faeces and subsequent composting of toilet waste in a composting installation meets differing reactions. The green composters of BVOR do not see much of a future for composting of faeces and in their open air installations it would simply not be possible. Smout (BVOR): “It might be possible in GFT composting installations. However, the risk of pathogen spreading in transporting untreated toilet waste is high. Anaerobic digestion after vacuum transport would be better, since this leads to further degradation, decreasing the volume as well the risk of pathogen contamination and the medicine residues. In principle the digestate could be used as fertilizer or composted afterwards, but for safety reasons I would suggest incinerating.” When the faeces would first be dried-in like in the Nonolet toilet (developed by the 12 Ambachten), transport and handling problems are reduced substantially. But, and this is also the main argument of Zeeman (WUR/LeAF) against composting, is the average Dutch citizen prepared to cover up his deposits after every toilet use and bring a bag of dried in droppings to the container? Smout (BVOR): “You should market it well, I see good opportunities in the recreation sector as an alternative for the chemical toilet: it saves you dragging with big water volumes and saves energy”. Scholten (BVOR): “But you lack the infrastructure also on camping sites. It will stay a niche for the eco-minded”. Zeeman (WUR/LeAF) adds: “A dry system would technologically seem to be perfect, but within DESAR we want to develop a system which offers minimally the same comfort level as the current system. Therefore, we have chosen for vacuum toilets and urine separating toilets as we expect to reach a much wider public with them. “Another important advantage of digestion is that you generate energy, whereas composting requires energy. However, with

²² This was indeed planned on, but due to problems with the gas company (NUON took over CORE and did not want to continue participating in the project) this has not yet been realised. (Mels *et al.* 2005)

composting natural drying takes place, whereas after digestion you have to drain and subsequently treat the water fraction, a process consuming part of the generated energy.”

Palsma (STOWA) raises another doubt about composting: “Maybe you find some farmers willing to take some compost. But the administrative responsibility lies with the district water board and I do not think that they want to make themselves dependant on an outlet market. I do not say that it is not an option, but I think you have to create a setting in which the municipalities and district water boards keep control over the primary processes, otherwise they will not accept it – normal, they are responsible”.

There are also organizations with a much more positive view towards composting of toilet waste. WASTE saw good opportunities in 2002 (article in Afval!), but the symposium they wanted to organize about it with the solid waste sector never got off the ground, due to a lack of interest from this sector (Geurts, personal communication). Most enthusiastic about composting of human faeces are the 12 Ambachten and composting/digestion firm Orgaworld B.V. which did a successful batch experiment with processing dried-in faeces from Nonolet toilets that were placed at an event site in 2004. The faeces were first digested anaerobically and then composted. Orgaworld is the only organic waste digester in the Netherlands. The collection of human faeces together with the GFT is not legally allowed (yet). Orgaworld sees the combined collection as a good opportunity and would be willing to take in big quantities of toilet waste in the future as they see the demand for compost rising. When asked whether the collection of the toilet waste could also be done through vacuum toilets and pipes (to improve citizens’ comfort), H. Bomen (Orgaworld): “That does not matter to us, collection is not our business, we leave it up to others to decide on the best logistical system”. Orgaworld has also finished a successful trial on the collection and treatment of diapers in Almere together with the municipality, subsidised by SenterNovem with VROM in the commission.

Leeflang (12 Ambachten) does not share the DESAR conviction that citizens are not prepared to turn in any comfort: “I think we should step away from the idea that citizens cannot do anything themselves – we should let them make efforts too as our current lifestyle is untenable in the long run. If you explain people well why a different system is better, they agree that change in the form of different sanitation like the Nonolet is needed. In an internet enquiry the majority of the people agreed with this – which of course does not say that all of these people would actually go and use it themselves... But if you think of the money this could save us: the sewerage levy is going to double as an effect of laying double sewers now! Are people prepared to pay that? And think of the extra employment a different system would generate!” “I do not underestimate the difficulty of changing behavioural patterns: it may be harder to change toilet patterns then convert a Muslim in a Christian and vice versa, but on the other hand... the people that come to our centre for courses do use the Nonolets without any problem after some initial confusion. Has it ever really been tested??”

In Germany testing is taking place with urine-diverting toilets, in which the faeces are transported away by gravitation and afterwards composted in a reactor. This was estimated a lot cheaper than anaerobic digestion after vacuum transport, but water consumption was higher. (Peter-Frölich *et al.* 2003) This option – that seems to mean less compromise to comfort than the Nonolet - is not being investigated in the Netherlands.

In table 4.4 a summary of section 4.4 is given. Most remarkably is: that composting has few supporters, but that there are a lot of actors without a clear preference for either anaerobic digestion or urine separation.

Table 4.4: Seeming preference for techniques amongst the actors

	Composting	Anaerobic digestion	Urine separation
12 Ambachten	+++	0	+
WASTE	+++	++	++
LeAF	0	+++	+
WUR	0	+++	+
Grontmij	0	+	+++
TU Delft	0	0	+++
STOWA	-	++	+++
RIONED	0	+	+
VROM	-	-	0
BVOR	-	+	+
Waterboard Reest & Wieden	No preference		
RIZA	No preference		
Waterboards			Slight preference for urine separation ²³
Municipality	No preference		

4.5 Nutrient and organic matter recovery

4.5.1 Importance of nutrient recovery from black water for eco-sanitation

As stated earlier, by Palsma (STOWA), Swart (Grontmij) and Loosdrecht (TU Delft) nutrient recovery is not seen as prime reason for implementation of new sanitation concepts, prime reason is the more cost-efficient (especially Swart stresses the cost advantages: “the economic side might turn out to be most important”) and effective wastewater treatment. They state together with Zeeman (WUR/LeAF) that also without recovery new sanitation could be a success and firmly disapprove of the idea that if there is no demand for the nutrients, then an important justification for the development of new sanitation is gone.²⁴ In a preparation report (Roorda, 2005) for the NP-project it is even stressed that much caution is necessary in naming reuse as an advantage of urine-separation; in Germany and Sweden disappointment with the difficult outlet in practice, had a negative influence on the use of urine-separating toilets.

That nutrient reuse/recycling (no matter from which source) will be necessary in the future is clear, especially for phosphate as that is a finite resource ending probably within the century. But Loosdrecht (TU Delft) states that urine separation in Western-Europe cannot be justified solely on the grounds of nutrient recovery, when looking at energy analyses and availability of animal manure from which extraction will probably be more efficient; “in the Netherlands, cattle produce four times as much nutrients in their urine than human beings.” If one only focuses on improving the working of the

²³ When looking at the projects that are now planned on: www.stowa.nl

²⁴ This is contrary to the Swedish situation, where ecosanitation was developed with ‘closing the loop’ to agriculture as the main reason (Jönsson, 2005 at PAO-course in Wageningen). The development was there pushed from the government by laws on recycling targets and financed partly by the agricultural sector.

WWTPs one could even choose to dispose of the separated urine in the GFT-container, according to Loosdrecht. Still, if separate urine collection and treatment could lead to considerable benefits for conventional wastewater treatment, urine would still present a highly concentrated source of minerals that could be recovered.

The 12 Ambachten and Orgaworld stress that rather than recycling nutrients, it is important to recycle organic matter. “Animal manure is still a net-subtractor of organic matter to your soil, only compost adds organic matter”. Composted toilet waste or faeces (whether or not digested first) can thus be interesting now that awareness is growing in the agricultural sector over the need to replenish organic matter to the soil.

Anyhow, answering the question what will be done with the source-separated urine or faeces, is essential for further development, also according to Swart (Grontmij). The issue is leading to question marks for all the respondents and especially the water board is very concerned with this. In the context of the Nieuwe Plassen-project in Meppel no effort has been made to solve the question of what to do with the urine once separated. The project initiator made the deliberate choice to only focus on the acceptance of the toilets by the users and cleaners. Swart: “Experience has learned that if you want to handle all questions in one pilot, you fail. And anyhow I want to leave answering the question of what to do with the urine to the experts in wastewater technology”.

4.5.2 Demand for source-separated urine

Unlike in the past – before the invention of artificial fertilizer – there is no spontaneous demand for human urine or faeces and it might turn out very hard to create one. In Sweden direct application of urine after storage (to kill-off pathogens) is taking place on local farmland and public green. From cost-benefit analysis this seems not very beneficial for the municipalities: they often need to pay farmers for take-off as spreading the urine is more expensive and yields somewhat lower than with artificial fertilizers (Degaardt, 2004). In the Netherlands the situation would be more problematic, because of the high amount of nutrients available from the waste of animal husbandry in combination with the lack of available farmland close to cities. Respondents furthermore name as inhibiting factors: the unknown risks of medicine/hormone residues²⁵; the (perceived) pathogen-risk; high ammonia emissions and the big volumes one would then need to transport. A plus of source-separated urine above animal manure and artificial fertilizer are the lower concentrations of heavy metals per gram nutrients.²⁶ Most nitrogen in urine is present in the form of ammonium, while plants mainly take up nitrate. Improving its quality as a fertilizer could be done by partly nitrifying in an aerobic bio reactor, which is being developed by Swiss research institute EAWEG. (Mels et al., 2005)

In 2003, Bureau ter Bevordering van de Mestafzet and Centrum Landbouw en Milieu stated in interviews with WASTE that there is no shortage of organic fertilisers due to the animal manure oversupply.²⁷ A new product would thus have to compete with artificial fertiliser, supplied at lower price. Practice learns that outlet of liquids is hard, when organic matter content is low and water content high: the case for urine. Also the high salt content of urine can form an impediment. According to them, problems with acceptance of application of human excreta do not lie in the agricultural sector, but with consumers and the food sector: partly this is a realistic threat, but much is perception. Even with a sound hygiene story it would be hard to change this fear. Therefore the

²⁵ EAWEG is currently undertaking research on the possibilities for removal of these micropollutants by ozon etc.

²⁶ Provided that storage takes place in plastic tanks; even the use of metal screws can elevate heavy metal level significantly due to the acidic nature of urine. (Jönsson, 2005, PAO course Wageningen)

²⁷ The idea of an oversupply of nutrients in Dutch agriculture is sometimes contested (in my research most prominently by WASTE, LeAF) with the argument: if this is the case, then why do Dutch farmers still buy lots of artificial fertiliser?

utilization in non-food agriculture would be easier: in the bulb sector, tree nursery or growth of starch potatoes.

Van Dijk (NMI): “Dutch agriculture is not waiting for even more nutrients. Competition of any of these products (digestate, urine, struvite etc.) would be fierce. The question will be how much you can pay the farmer to utilize your products; since the economical interests of pig farmers to get rid of their manure is huge. This will not change in the future: a slight decline in animal manure supply will be offset by extensification and ‘broadening’ of part of the agricultural sector, decreasing demand for nutrients.” “However, organic matter is another issue”. (See 4.2.3)

Some research was done by the EAWAG on the acceptance by citizens and farmers in Switzerland on using urine-based fertilizers. The majority of the citizens were willing to buy vegetables fertilized with human urine. Some worries were raised on hormones/medicines and the effect on health. Under farmers the acceptance was high: 57% deems it a (very) good idea and 42% was interested in buying a urine based fertilizer. The situation for animal manure in Switzerland however, is different from the Netherlands.

4.5.3 Industry’s interest in urine and struvite

Very little is known about the demand for struvite (see chapter 3.4.3) in the Netherlands. Contact with potential demanders of struvite does not take place within the DESAR project, except for the contact with Thermphos. Grontmij does not have any contact with potential customers.

Schipper, nutrient recycle specialist at Thermphos, says they are interested in recycled phosphate from any source, but state clearly that for the time being they are only interested in the solids, they will not handle urine or other liquids themselves. “We would be very reluctant to change that, as it would require major investments and we are no wastewater treaters. But if everyone would be left with big quantities (10000 ton) semi-liquids, we would consider building a dryer – for pure liquids not.” “Of course transporting big volumes of urine with such a low phosphate concentration to Zeeland (where Thermphos is located) would also be energetically irresponsible.” As they use phosphate amongst other for food products, problems might occur with acceptance from their customers. “We do not yet know this well. Nor have we decided whether we should inform our customers from which source we tap. We are an exception in this sense that we produce phosphor or phosphoric acids ourselves and then process them further into derivatives, other companies just buy the phosphor on the world market and no-one asks them about the origin.” “I think that nutrients recovered from sewage sludge have a better connotation than those from human urine or faeces alone”.

Thermphos is successfully recycling potassium struvite coming from calf slurry. They also participated in a trial on ammonium struvite (the most common form of struvite) recycling, but Schipper states that this results to be a bad option for them, as it leads to high ammonia emissions in their production process. They can use calcium phosphate and do some for free from one WWTP. According to Schipper the artificial fertilizer industry is not interested in struvite either, although chemically it seems to be a good fertilizer. Zeeman shares this opinion: “Struvite is a good fertilizer widely used in Japan, but the Dutch market is in the hands of big parties, having vested interests in selling their own products. This also became clear with the experiment in Gelderland with struvite from calf slurry. In the 1980s I came into contact with DSM while working on ammonia stripping, then they were not interested either; they have their own products. It will be hard to create a market for a new product; we will need creative people for that.”

Her view is contested by Langeveld, managing director of the artificial fertilizer company Amfert, who declares that they do have interest in using struvite and that they are involved in research on the use of struvite for fertiliser production. They have utilized a small amount of struvite produced out of calf slurry from the pilot project in Gelderland and even got some from Japan. Langeveld does not have an a priori preference for the source – animal manure, sewage sludge or human urine etc. – from which the struvite originates. “What counts is the purity of the product and I have no figures about the

different sources. High heavy metal contents would be problematic and it is important that as little as possible organic additions are present in the struvite delivered as this can give problems in the production.” Mels (2005) states that urine contains a relatively small amount of organic substances, but whether that also results in relatively ‘clean’ struvite is not stated. Langeveld does not fear pathogen problems, nor does he think his customers will have anything against the use of struvite products produced out of animal manure, sewage sludge or human urine/ faeces. However, Langeveld warns that the value of struvite as is named in publications is way too high, the price Amfert is prepared to pay will be much lower: “We would pay something, but very little – it is a second-rate product for us”. He also states that direct application of struvite as a fertilizer is only possible for very specific applications for which no continuity can be guaranteed. To make it into a good fertilizer struvite first has to undergo a chemical treatment in order to change the nutrients into a plant-available form. This chemical treatment can be performed at Amfert. He can imagine his competitors are not interested in struvite, as they cannot perform the necessary chemical treatment. Calcium phosphate resembles apatite very much and would be the easiest form for the fertilizer production: it could be used by any of the artificial fertilizer companies.

The reuse/recycling of nutrients on big production scale would be interesting for Amfert already in the near future: the only obstacle is the non-availability/non-supply of large quantities of minerals that can be recycled. They are waiting for the supply of large quantities. Langedijk would like to see more research on what can be done with struvite, as now “research is limited to how it can be extracted and from which sources”.

The struvite precipitation would have to take place at another location, as it would be problematic for Amfert to obtain the necessary permits for the treatment of urine, it would bring stench and hygiene trouble. The advantage of selling the struvite to Amfert is that they can process very large quantities and that they are not dependent on seasonal patterns because of their world-wide market. “If an WWTP is going to put the product in the market by itself, it will not have customers half the year.”

The actual mineral recycling taking place at the moment at Amfert is minimal – calcium phosphate from WWTPs – but they are also involved in a project where chicken manure will be burned and phosphor and kali recycled out the ashes.

The other artificial fertiliser companies that were approached in this research, DSM-AGRO and Zuid-Chemie, were much more negative in their reaction. Different from Amfert they purchase ready-made ammonia/nitric-acid and DAP from other plants to then process them further into granulated artificial fertilisers. At DSM-Agro no mineral recycling or any research/experiments thereafter take place. No interest in doing so is showed either. Heers, sales manager at DSM-Agro: “It would be more likely that those initiatives would take place within the companies that supply us.” All the processes within their factory are targeted at the processing of solid material, so there is no interest in taking off liquids like urine or manure. When Heers understands that struvite, a solid substance, can be retrieved from the urine or animal slurry at another location by another actor: “Since it was a liquid, extra logistics will be needed to transport, process them etc. This will cost money and our aim is to provide farmers with low cost artificial fertilisers, so we would have to see if this is not going to be more expensive”. Another point of attention is the quality of the material, defined as the constancy of the composition. “Fluctuations in the mineral contents mean that we will have to do more ‘tinkering’ and this is also more costly”.

Heers thinks it is more likely that reuse takes place round DSM-Agro, by other more local actors that are in close contact with the farmers. “You see that with kali-vinasse that is now being sold and distributed by the same local contractors. I do not see this as a threat to our company: if efficiency gains can be made reusing organic fertilisers, then this may benefit the whole agricultural sector: if ground water contamination can be diminished, this may lead to a relaxation of the nutrient application standards and we would gain part of that benefit too.”

Wille from Zuid-Chemie: “Speaking in general these substances [recycled nutrients out of organic/liquid sources] are economically not attractive, due to the fierce competition with cheap mined phosphate and pure ammonium; therefore reuse for us only becomes interesting if it would be subsidised, because it could help to solve a societal problem – land filling also costs money.”

4.5.4 Agri-organisations on struvite

Stichting Mestverwerking Gelderland, produces a few hundred tons (up to 500 tons) of potassium-struvite per year out of calf slurry, which goes to Thermphos BV. Van Veen (SMG) “We searched for a very long time and no other dealers in the fertiliser market were interested.” Whether Thermphos pays and if so how much is ‘confidential’. Van Veen: “The route to Thermphos for ammonium-struvite has been closed now. So I think that if more struvite will be produced, for example from urine, the establishment of a bigger organisation that will take the marketing at hand is most likely; that will create a new market, find a niche. This should well be possible, since before the 1960s struvite was commercially marketed as a fertiliser in some European countries, but later on it got out-competed by the cheaper triple-phosphates.” “It will be a hard and long trajectory, but the water boards have via the STOWA enough resources to realize research. Like some years ago the drinking water companies were left with a number of effluent substances, but after some research, they have found excellent purchasers for them. SMG is too small for that.”

Van Dijk (NMI) is less positive: “In the Netherlands there hardly seems demand for struvite as a PK-fertiliser. And this will not rise in the future, since the room for artificial fertilisers will be declining with the new mineral regulations²⁸ and so for its substitutes – well this depends of course on how they are categorized.” In Belgium there is no market either, export possibilities might be better in France or Germany. ” He contests Langendijk’s view that the minerals in struvite are not-plant *available*: “availability depends on solubility and the pH (which is generally very high in 60% dry content-struvite) is buffered in the soil, raising solubility to values comparable with artificial fertiliser. However, struvite does not possess the right mineral *proportions* for every plant. So it will prove hard to deliver unprocessed struvite as an artificial fertiliser substitute, guaranteeing fixed contents and the right mineral distribution. Nonetheless, I do not believe that agronomic value of struvite will be the bottleneck, the bottleneck will lie in the fierce competition and getting it accepted as a fertilizer.” “I do not believe Amfert is very interested in struvite and struvite is not at all seen as a threat by the fertiliser industry. Besides, the procedures to get something regulated as a fertiliser is a long way.”

Heijmans (LTO): “We are also in favour of reducing artificial fertiliser use which is unsustainable from energy/ environmental perspective. Some farmers have a preference for its use, since it is easier to direct application throughout the season. Besides the mineral regulation only allow part of the total fertiliser use to come from animal manure. We want to develop an artificial fertiliser substitute on the basis of animal manure: separating the liquid part containing most of the nutrients.” “They [sanitation developers] can better develop a granular fertiliser out of the toilet waste and export it. No one wants to be left with animal manure again, do they?” “However... if this could lower our efforts for the EU FDW, because the wastewater sector is doing more... we might be able to do something back by using their products on our land.” (see as well 6.5.3)

4.5.5 Demand for compost and digestate

Untreated spreading of faeces on agricultural land is unimaginable nowadays due to high pathogen risk. In the form of sludge from anaerobic digestion or compost it could potentially be applied in agriculture. In the DESAR project no research has been done yet on how to get best rid of the

²⁸ Over the coming years the amount of animal manure that farmers are allowed to apply, declines slower than the total permitted amount of fertiliser, leaving less space for artificial fertilisers. Van Dijk (NMI) in his interview.

digestate, although this might have considerable impact on which extra processing steps need to be performed, on the logistics and thus on the costs. There was only a research showing the relative cleanness (in terms of heavy metals) of the digestate compared to sewerage sludge from a communal WWTP (Mels *et al.* 2005). Leeftang (12 Ambachten) sees a fundamental difference between digestate and compost: “Compost secures a lively soil by devolving organic matter and hence a sustainable agriculture. Digestate does not have the same soil improving characteristics – it is of no use to agriculture. However Orgaworld developed a process by which the digestate is successfully composted afterwards, retaining its good qualities.”

The green composters of the BVOR are not interested in the addition of toilet waste to their composting process, not even when demand for compost would sharply rise, as the investments and risks to handle an ‘impure’ product are simply too big. For Orgaworld growth in the demand for compost is one of the decisive factors for interest in the use of toilet waste. Over the last few years the demand for compost seems to be clearly on the rise, after periods in which compost sometimes even had a negative market value. Van Bomen (Orgaworld): “Five years ago it was often hard to get rid of the compost, but now they are taken it off as soon as it is ready. Not just we, but all our colleagues are dealing with shortages of compost. The demand from the potting soil sector, but also from the agricultural sector is rising. The agricultural sector is finally realizing that it has to combat the decrease in organic matter in the soil, so that aeration, water and nutrient retention improve.” Van Dijke (NMI) agrees with him: “Cheap nutrients can be found anywhere, but organic matter is a problem. There is a growing demand for organic matter in arable farming and especially in horticulture. A product that can deliver organic matter which is enduring – the organic matter in pig and poultry manure is not enduring – and has a low nutrient content, would be wanted.”

Mineral regulation for the agricultural sector can have a significant influence on the demand for the coming years. Van Dijke (NMI): “Only when this new product with toilet waste would be considered to fall under BOOM²⁹ and treated like compost - which gets a 50% exemption for P and 90% for N in the mineral accounting – it is interesting for farmers.”

Mineral regulation was also a major obstacle to the further development of ‘enriched compost’: product of the combined composting of green waste and animal manure, which would combine a soil improver with nutrient application. In the end of the 1990s a research was conducted by TNO-MEP in cooperation with the BVOR on this, showing that the technical possibility, the quality of the end product and the potential market then seemed rather promising. But since the product contained processed animal manure, it was counted just like pure animal manure in the mineral accounts and thus farmers had no interest. A lot will thus depend on how compost to which toilet waste is added in the process is classified.

According to Titulaer (oral statement, 1st February 2006) the income from Orgaworld’s Biocell plant in Lelystad is roughly generated by three sources: 60% is the money they receive from the waste suppliers for processing their waste, 30-40% for the energy they generate and generally less than 10% by the compost they sell. Therefore one should realise according to Kaskens (Orgaworld, interviewed by Bijleveld, 2003) that “We do not accept any waste that is not paid for by its suppliers”. At the moment, 80/90% of their customers are in the agricultural sector. Compost sale to this sector does not generate real profits. But now that they have developed a good peat-substitute, sales to the potting soil sector will increase, where prices are 100% higher and some real profits can be made. In the future Orgaworld would therefore be interested in more quantities of organic waste, like toilet waste, to produce more compost and energy. “We have the permission to digest animal manure as well and

²⁹ BOOM is short for Besluit kwaliteit en gebruik overige organische meststoffen, a regulation about all the organic fertilisers which are not considered as animal manure. BOOM sets quality standards in terms of allowable heavy metal load etc. Substances falling under BOOM get a partial exemption in the mineral accounting.

toilet waste can be realised within this permission too. The province has granted us this wide permission with eye on the future processing of more streams.”

One of the employees of the 12 ambachten declares that many farmers in the Noord-Oost polder are happy with the addition of dried faeces in the composting process. “The “enriched” compost produced meets with eager demand. The reason for the farmers’ preference of this product above animal manure is that it does not have the problem of high ammonia volatilization and acidification as there is no urine present, but has a much higher fertilising effect than normal compost.”

This view is contradicted by van Bomen at Orgaworld, for which the addition of human toilet waste does not signify a surplus-value, as farmers are looking for a soil structure improver in compost; “that is what they pay for, not the addition of extra nutrients”. The compost made out of the digestate to which toilet waste was added, will therefore not be sold separately, but just goes on the ‘big heap’. “Analysis showed that there were no significant differences with normal compost. Furthermore we have conducted a survey among our customers to ask them if they care. Conclusion: for them it does not matter from which source the compost originates, as long as the product is pathogen-free, weed seed free etc. There is no problem in guaranteeing that.” Kaskens (Orgaworld): “Farmers normally do not care from which source it comes, it would be the Albert Heijn that might make trouble.”

In principal Orgaworld could even add urine to the digestion process, van Bomen: “The possibility should be investigated, but I do not see any problems. There are two ways of digestion, dry (from till an organic matter content of around 25%) and liquid digestion – we do both, urine would then fall in the second category”.

4.6 Conclusions

The problem definition of the current situation differs considerably amongst the interviewed. The developers of alternative sanitation naturally stress the negative sides of the current sewerage system. For most of the interviewed a more cost and energy-efficient and effective wastewater treatment is the prime advantage of source-separation of black water. A smaller part of the innovators (WASTE, 12 Ambachten, WUR, LeAF) finds nutrient and organic matter recycling also important.

When evaluating the perceived need for source-separation of black water, I think roughly four groups can be distinguished in order of declining perceived need: “believers”, “pragmatic proponents”, “neutrals and “disbelievers”. The true “believers” then are: WASTE, 12 Ambachten, the WUR Environmental Technology Department and LeAF. The “pragmatic proponents”: Grontmij, STOWA and TU Delft. The “neutrals”: RIONED, DG Water, water boards. The “disbelievers”: RIZA, VROM, municipalities. The neutrals and to an even greater extent the disbelievers stress the advantages of the current sewerage system, namely high user-friendliness combined with relatively high hygiene and environmental performance. They are generally more optimistic about the results that can be achieved with end-of-pipe technology. They are sceptical about the benefits of a transition towards source-separation compared to the costs, which they believe to be huge.

There is still a lot of uncertainty about which sanitation concept is best in which situation. A more diverse pattern of sanitation depending on local conditions is expected by some. A preference for vacuum and urine-diverting toilets over dry toilets can be noted amongst most of the interviewed, because of higher perceived user’s comfort.

The untreated spreading of urine has very little chance of diffusion in the Netherlands. The phosphate processing industry shows little interest in struvite, except for Amfert who are also willing to participate in a pilot. The agri-sector is generally negative about the chances for digestate or artificial fertiliser substitutes from toilet waste, because of the abundance of animal manure and the tight

regulations. There is growing interest for products like compost that can add enduring organic matter to the soil.

Chapter 5 Networks, cooperation and translation

5.1 Introduction

Having a clearer picture of the different actor's involvement in alternative sanitation development, their ideas on the current situation, problems and alternatives, we will now focus our attention on the interactions between the actors. Who is in contact with whom, which actors cooperate and which clusters can be distinguished?

In figure 5.1 the linkages are visualized with a dashed line showing contact and the straight lines showing cooperation on the issue between the actors. Some ellipses have appeared, signifying clusters or networks: one ellipse uniting the actors that are part of the current policy network around sanitation and wastewater management and two ellipses to show innovation networks. The upcoming section (5.2) will treat the cooperation between the innovators – the people and organizations involved in the development of alternative sanitation – and explain why one cannot see them as one unified network. Next (in 5.3), attention will be paid to the contacts and cooperation of the innovators with the outer world, with those organisations they want to interest in their projects. Ample attention is paid to the difficulty the DESAR and Grontmij projects have in involving some actors, especially the municipalities and the national administration. This will be explained by the division of tasks in Dutch wastewater management, but also in the 'self-referentiality' of the innovators. In the synthesis (5.4) at the end, concepts from the Actor-Network Theory (introduced in Chapter 2) will be used to aid the analysis. This will show us how the innovators have worked as engineer-sociologists trying to build actor-networks with examples of successful and flawed translation in our case.

5.2 Contacts and cooperation within the innovation network(s)

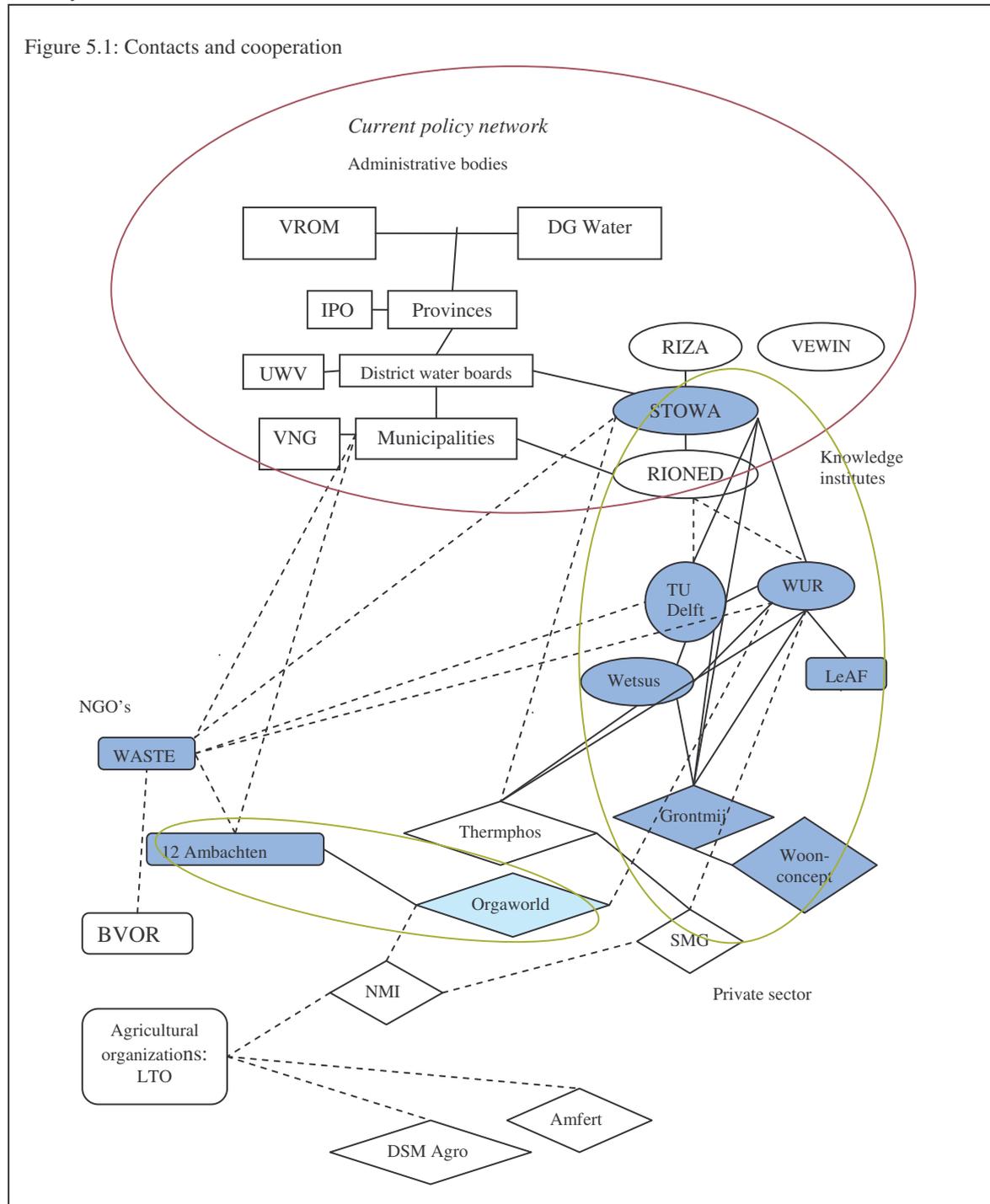
5.2.1 A unified innovation network?

There seems to be a split between the different groups and organizations working on alternative sanitation. Most prominent is the group around STOWA and the DESAR-project to which Grontmij is closely linked, with DESAR concentrating more on black water digestion and Grontmij focusing on urine separation. The ties among the involved in this group are strong, mutual appreciation for activities and strategies exist. The scientists from TU Delft, WUR and LeAF have managed to successfully enrol STOWA in their network. This has proven an important player for the continuity and amplification of their project, because of its financial resources and because of its good contacts and reputation with the water boards and RIONED, RIZA, VROM and V&W. The DESAR/Grontmij/STOWA group – depicted in figure 5.1 as one of the innovation networks - has better contacts with the wastewater sector and seems to have more openings to the current policy network than WASTE and the 12 Ambachten have.

WASTE and the 12 Ambachten do not belong to this group, nor do they form one group together. These groups dispose of less resources to undertake research or pilots and are less close to the wastewater sector. Their advantages are their knowledge on and contacts with the organic solid waste sector, which has led the 12 Ambachten to the cooperation with several consultancies and with Orgaworld, proving that the 'product' from their toilets can be successfully processed and merchandized. Both of them have sought more contact and cooperation with municipalities (the sanitation/solid waste department) and provinces instead of with the wastewater sector, since their solutions with dry toilets and possibly joint collection with GFT would circumvent the water boards. WASTE is furthermore involved in an international network of development organisations that work on the realisation of ecosanitation in the so-called developing countries.

Between WASTE and WUR, TU, STOWA contacts do exist, but cooperation does not always seem pleasant or easy. WASTE declares that cooperation with the WUR has not always been good. Palsma (STOWA) explains that he does work together with WASTE when possible, but they disagree on some crucial matters and have a different strategy. One of the outings of this is the disapproval of Palsma (STOWA) of the use of the name ecosanitation as this does not “suggest that we are talking about a modern solution; I want to see chrome, marble, glitter and glamour to bring this across as a twenty-first century solution”.

Figure 5.1: Contacts and cooperation



The 12 Ambachten is described as a “very ideological, sectarian” organization by Gastkemper (RIONED) of RIONED, and as “not very willing to cooperate” by Geurts (WASTE). A difference of opinion also exists with regard to composting, a strategy which is favoured by the 12 Ambachten, to a lesser extent by WASTE and not by the DESAR group. When Leeftang is asked about 12

Ambachten's cooperation with other developers of "alternative" sanitation like DESAR: "To put it frankly, a deep abyss exists between those working on aerobic and those working on anaerobic techniques. There have even been times in which we were "not on speaking terms". Leeflang explains this out of their attachment to composting. "We have emerged from 'De Klein Aarde', an organisation very much focused on sustainable agriculture, and we thus have started from the interest of closing the cycles with agriculture and the abolishment of artificial fertiliser. Compost is seen as fundamental to secure a lively soil by devolving organic matter and thus a sustainable agriculture, sludge from anaerobic digestion does not have these soil improving characteristics. However, in the last years, composting and digestion have been reconciled a bit by Orgaworld's invention, where the Lettinga reactor plays a role, but good compost is the end-product."

As noted before also an essential difference in point of view exists between DESAR/STOWA/Grontmij/ RIONED on the one hand, and 12 Ambachten on the other concerning the role of the consumer-citizen: 12 Ambachten believes a bigger role can be asked from citizens who might well be willing to change behaviour if this leads to considerable (financial) benefits.

Also between the 12 Ambachten and WASTE little cooperation takes place. Leeflang (12 Ambachten): "We had talks, but frankly saying I do not see much future in cooperation. They are concentrating very much on No-Mix toilets and were saying that NonOlet is not a No-mix toilet, although in 95% of the practical cases it does function like a no-mix toilet."

5.2.2 Coordination in a small circle

Nonetheless, most of the respondents feel that the initiatives and research on alternative sanitation in the Netherlands are generally well coordinated and linked and cooperation is mostly constructive. Only Schipper (Thermphos) – a relative outsider – has the idea that many initiatives are going on separately and finds that duplicate research is done on struvite precipitation. The respondents admit that it is still easy to coordinate the different activities as the circle of those involved in alternative sanitation is very small; everyone knows everyone else, also due to the fact that support often hinges more on one or a few enthusiastic persons than on the whole organisation. That it is a small circle is regretted, with Gastkemper (RIONED) hoping for more pilot projects and more knowledge exchange with other countries. But Zeeman (WUR/LeAF) also sees an advantage of a small circle at this stage of development: "If others start out with a project that is doomed to fail, or if you start with big projects that fail, this will result in a bad reputation for all new sanitation concepts." She refers also to the rapid set-up of a substantial number of similar dung digestion installations in the 1980s and the subsequent failure and loss of faith in the technology. And as Palsma (STOWA) says: "If things fail, the public does not distinguish between STOWA or for example WASTE".

It is felt that the circle is growing after the Nieuwe Plassen-project in Meppel and coordination will become harder, but the respondents have faith that coordination is guaranteed by the set-up of an umbrella group for separate and decentralised sanitation (in Dutch named: koepelgroep Ontwikkeling Nieuwe Sanitatie Systemen) and the writing of a strategy plan by STOWA. Much of the research is financed by STOWA and in the STOWA umbrella group on separate sanitation all research proposals that come in are discussed. STOWA is the one who by financing most of the research is coordinating a lot of it. The respondents seem to be content with this role of STOWA, as "the spider in the web". In the new ONNS-umbrella group until now a few water boards (Hoogheemraadschap Rijnland, Waterschap Hunze & Aa's and Reest & Wieden), TU and WUR, LeAF, Grontmij and RIONED are present, the 12 Ambachten and WASTE are not. Aim is to coordinate the initiatives, but also to bridge the gap between the alternatives and the conventional manner of collection, transporting and treatment of wastewater. Gastkemper (RIONED) is positive about this umbrella group "finally, alternative sanitation has come away from its geiten-wollen-sokken-image [Dutch expression for "hippie"-image], with renowned consultancies and a real university. And there is place for doubts, which I feel is important." RIONED itself is seen as rather conservative, Zeeman (WUR/LeAF): "I see them as

very cautious with regard to alternative sanitation. They follow the developments, but will not stimulate it themselves.” Gastkemper (RIONED) agrees with that.

Palsma (STOWA) has also been setting up a small ‘strategy group’ (consisting of Zeeman, K. Zagt who launched DESAH BV and Palsma himself) trying to come up with a deliberate strategy for future developments – which pilot projects to undertake, which actors to involve and when - and writing a ‘strategy note’³⁰ on this.

5.3 DESAR/STOWA/Grontmij cooperating with the outer world

In this section we will look at the collaboration of part of the proponents of alternative sanitation - namely the DESAR/STOWA/Grontmij cluster - with the parties they need for the advancement of their projects. First the contact with water boards and municipalities will be dealt with and ample attention will be given to the reasons for the difficult involvement of the latter (5.3.1). This results in a debate on the necessity of new institutional task divisions in the wastewater chain (5.3.2). Other factors that might facilitate the involvement of municipalities are named (5.3.3) and this results in more general points of attention for project management as well (5.3.4). Next, attention will be given to the reasons for the (almost) absence of contacts with the national government (5.3.5) and nutrient recyclers.(5.3.6)

5.2.1 Cooperation with water boards and municipalities

A difference can be observed in the ease with which to involve municipalities on the one hand and water boards on the other. While the first water boards are now willing to start a pilot-project, municipalities are still very reluctant towards the idea of alternative sanitation. This is the picture painted by several respondents (Zeeman (WUR/LeAF), Palsma (STOWA)) and on the PAO³¹ course (mainly during the presentation of Braadbaart (WUR) and the subsequent discussion). The difficulty to involve municipalities also became apparent in talks with the municipalities themselves (Meppel and Alphen aan de Rijn).

Zeeman (WUR/LeAF) has the impression that cooperation with the water boards has improved considerably from the beginning of DESAR. “In 1999 the water boards were absolutely not seeing future for new sanitation concepts, now most of them have heard of it and the first of them are willing to start a pilot project.” She sees information dissipation on alternative sanitation and the pressure of the more stringent effluent requirements of the European Water Framework Directive as reasons for this improvement. However, she stresses that it still depends on a few persons in the water boards; it is clearly not yet a generally accepted alternative.

On the contrary, Zeeman finds the cooperation with municipalities still very hard, with the exception of Sneek. She attributes the failure of pilot-projects in Wageningen and Emmen for an important part to the attitude of the municipalities. She also notes the absence of municipalities on the two symposia organised by DESAR/STOWA.

The division of tasks between the municipalities that are only responsible for the sewerage and the water boards that are responsible for wastewater treatment is seen as the main reason for the disinterest of municipalities. Zeeman (WUR/LeAF): “After all DESAR is offering a total solution, which does not respect these administrative borders.” The water district boards have a clear responsibility for improving purification and out of this the necessity to innovate occurs more naturally. It then depends on the people within the water boards whether they are more interested in optimising end-of-pipe solutions (Palsma (STOWA): “And that can be just as good!”) or in separation at source. But

³⁰ The strategy note “Anders omgaan met afvalwater” is in preparation and due to be published at www.stowa.nl Spring 2006.

³¹ PAO-course “Gescheiden inzameling en behandeling stedelijk afvalwater”, 17-18 November 2005, Wageningen

municipalities do not share this sense of urgency; it is not clear what advantage new sanitation could bring to them and they are afraid of the extra costs. Like the municipality of Meppel and Alphen aan de Rijn say: “We do not see any advantages for the municipality itself, it will only cost us a lot of money.” Van de Bles (Meppel): “If we do it, it will be to help the water board, with whom we have a good relationship and from the idea that we are together responsible for solving societal problems. The same goes for our current investments in the construction of rainwater sewers. The water board has to come up with a good proposal for cost division: if they can economize on water treatment or postpone investments then they can maybe lower their tariffs, but ours will have to rise. How that is arranged is very important for the municipality.” Municipality employee Alphen aan de Rijn after two days of the PAO course: “It is still not clear to me, if anyone will gain – of which I am not even convinced - it is not us but the water board. But without us it simply is not going to take place.”

As Palsma (STOWA) illustrates: “Me and Bjartur Swart (Grontmij) tried to talk in on the people from the municipality of Meppel for a long time trying to get them to feel that there are problems and that they are partly responsible for the problem, that they have to think about the future of their sewerage system and that out of this need and responsibility it would be good if they got involved in the NP-project. That consciousness did not come, but when they heard it was only about three toilets, they said, oh well, just go ahead... For them sewage overflows are more of an issue, if you would come to talk about ‘disconnection of rainwater’, which is their core responsibility you would probably get much more response.”

Another reason for disinterest, as stated both by Braadbaart (2005, PAO course Wageningen) and Mels *et al.* (2005a: 5), is that municipalities often lack the knowledge and expertise for wastewater management. Contrary to the advanced professionalization in wastewater treatment, the municipalities are struggling with capacity shortages. As a result the sewerage is often badly mapped, growing ‘autonomously’ with the building of new neighbourhoods and there is a limited overview of the costs. Moreover, it is apparent that many municipalities have to go through a lot of pains to come forward with the necessary funding for expected renovations and improvement of systems.

5.2.2 *New divisions in wastewater management*

An ongoing discussion takes place on whether there should come a new institutional task division for wastewater management. In February 2004, the central government presented a vision for coming to a division in tasks based on simplification and disentanglement of the water system (the visible water) and the water chain (the water in pipelines). Moreover, secretary of state Van Geel is a strong proponent of the establishment of water chain companies, in which sewage transport and treatment and eventually drinking water production are brought together in one company. An integrated water chain tariff should be introduced in the longer run, which makes the costs of drinking water, sewerage and treatment dependent on drinking water use.³² The municipalities united in the VNG did not agree with these proposals at all (see the VNG publication: Baas in eigen buis, 2004): they want to keep the director’s role in the urban area as they feel they are the right party to integrate local rain, ground and wastewater management into the urban infrastructure. Arguments are: firstly, that rain and wastewater management will (at least for a long time to come) remain inseparable as disconnection only takes place slowly and full-scale disconnection might not be societal optimal at all. And secondly, that municipalities will be the ones most likely to come up with cost-efficient solutions as costs for sewerage are said to be mainly dependant on the fine-tuning of sewerage renovation with road construction. VNG therefore proposed a broadening of the municipal sewerage levy (for which a bill is currently on its way³³) and of the municipal sewerage plan with ground and rainwater policy and services. They are not against stronger cooperation with the water boards or against hiring private

³² “Scheiding tussen keten en systeem moet kosten stijging in de hand houden” (19-02-2004) at www.waterforum.net

³³ “Gemeenten vrij in bepaling van hoogte verbrede rioolheffing” (14-04-2004) at: www.waterforum.net

parties for some tasks. But important is to not lose the direction, therefore they opt for 'wastewater pacts' or 'water plans' instead of 'water chain companies'.

The VNG advocates a common establishment of water system ambitions with the water boards, as the municipalities feel that in the past ambitions were put higher than they preferred, while they were the ones bearing the costs of the measures. This was/is at stake in the following dossiers: system choice of sewerage systems; reduction of sewer overflows; handling rainwater differently; the ambition level that is being defined on the basis of the EU WFD; putting an end to the wastewater discharges in the rural area. "Extra (sewerage) investments will have to be better motivated: the municipalities are the ones to pay and they have to deal with the critical local politics following the development in financial burdens with scrutiny. Only if costs and benefits are clearly presented, a good deliberation can be made: money you spent on sewerage cannot be spent on education or health care, so we have to be sure they render societal benefits", according to the VNG. Furthermore, water boards would have to contribute fifty percent of the rainwater disconnection costs. (VNG, 2004)

Braadbaart (WUR) suggests to (partly) take away the responsibility for wastewater transport from the municipalities. He is surprised by the power of the municipalities in their resistance to releasing control and losing the fiscal instrument of the sewerage levy. Together with the technological lock-in, he sees this as major obstacles to change in the water chain. De Boer (Municipality Meppel) utters the same deliberations as the VNG. Gastkemper (RIONED) supports the municipalities: "The current organization has pros and cons; advantage is the bigger scale of water treatment that is achieved, disadvantage can lie in the shifting away of responsibilities. But there are mechanisms that counter this, like optimality research. The water chain company in Amsterdam only works well, because the municipality did not lose its say. Believe me: they are not interested in controlling what is going to happen with the wastewater, what concerns them is spatial planning."

Palsma (STOWA): "I think we should keep the administrative responsibilities like they are. It would only be the central government that could change those anyhow. This does not mean that you cannot cooperate in new ways. Besides, the municipality or water board could always out-source the collection or treatment to other parties – for example to companies that already digest organic waste."

According to Swart (Grontmij) a logical distribution of the tasks depends very much on the technology chosen: "Of course this is a very hard matter, as now there is a clear division of tasks between the municipality and the water board and no-one feels like starting a discussion about that. But if you separate the urine and try to find a market for this, it is not logical to first transport it to a WWTP, but let the municipality deal with it. If you get all those Grietje Zeeman- UASB reactors, should the district water board then go daily through the neighbourhoods to manage them? It will be more logical if this becomes a task for the neighbourhood management (dutch: wijkbeheer). The energy too will be generated on that level." However, the municipalities do not feel like taking over any treatment tasks and Kool (water board Reest & Wieden): "The processing of toilet waste will remain our responsibility, whatever new techniques are used. But we can do this in partnership with companies. The ideal situation would be that companies come with offers and that we then choose, like happens with the purification sludge."

When asked if transportation and treatment of wastewater should not come under one organisation, Kool (Waterschap Reest & Wieden) thinks that new sanitation concepts will automatically put more of the tasks on the water boards, as it will be too expensive for the municipalities. "But we are talking about 2020, so I expect that by that time there will be much more cooperation between water boards and municipalities on wastewater anyhow, like it is starting today. This could lead to the establishment of one wastewater enterprise, but this should only be done if this turns out to be most efficient and cheapest for the citizens in a certain area. It should not be forced upon us from above."

5.2.3 Facilitating municipalities' involvement

A good relationship with the district water board could considerably facilitate the involvement of municipalities in pilot-projects. In Sneek cooperation seems easier because there is already a consultation body in place (Friese Wateralliantie) in which municipalities, water boards and companies work together. Van de Bles (municipality Meppel) stresses that one of the factors stimulating them to cooperate to the Nieuwe Plassen-project was their good relationship with the water board, with whom they already made a Water Plan before and have good consultation on fine-tuning tasks.

Other suggestions to facilitate the participation of municipalities in pilot-projects, Van de Bles: "I see the same reaction of municipality Steenwijk now as we had in the beginning: 'well just go ahead, building those houses, do not bother us with it, it is not our business'. Therefore I think it is important that you make very clear to a municipality at an early stage what interfaces there are with their tasks, why it is their issue, where it touches their terrain. Not necessarily only on sewerage, but maybe more from the common problem, common task you have with the water board for enhancing water quality. But also make clear what concrete tasks they could take on, like installing this pipe there or emptying a storage tank." "You should also try to figure out how sensitive they are towards the water board: if the relationship is good, it might sort more effect if the water board approaches them, asking the municipality for help to solve the wastewater treatment problems, than that a party like Grontmij calls. In our case this would probably have worked better, but there are also municipalities who are still very suspicious towards water boards."

5.2.4 Project management

What becomes clear especially from the interview with Palsma (STOWA) and Swart's (Grontmij) presentation on project (process) management at the PAO course, is that it is important to realize that each party, in order to make them cooperate, should be approached by his own arguments. Palsma (STOWA): "For the water boards it is often enough to show the pie diagram with the nutrient percentages in urine compared to the whole wastewater stream. For some housing cooperation you can aim at their wish to show involvement in societal issues. In Meppel this worked out really well: housing cooperation Woonconcept said it was doing a lot on sustainable building and Grontmij/STOWA asked if they were doing something with wastewater as well. "Then things went very rapidly as the coop got very enthusiast and soon we were in Sweden looking for appropriate toilets. The housing coop then also started pushing the municipality and district water board to make things move faster." But housing cooperations and project developers are in other cases often the ones opposing a pilot project. They are the ones bearing the greatest financial risks for building projects and are afraid of the reactions of future customers/residents. According to an employee of Waterschap Hunze & de Aa (at the PAO course) the project developer is the one most likely to obstruct ambitious plans for an emission free water chain in Meerstad. In Wageningen the project developer withdrew its support to a pilot when the vacuum toilets could only be delivered in two models and one colour. (Mels, 2005)

Swart (Grontmij) shows nicely in his presentation how the set-up of a pilot project may fail because of what in literature (Lems & Geldof 2004) is called 'self-referentiality' (Swart himself does not use this term). He distinguishes three groups which he terms 'the believers', the 'responsible' and the 'involved parties'. The believers are the idealists, futurists and scientists ("the Grietje Zeemannen"), who have the motivation, knowledge, vision and whose goals are to prove their right and knowledge development. They need the responsible, the policy makers and managers, who set the boundary conditions, norms and management goals and who aim for policy development, cost reductions and profilation. They also need other 'involved parties' like builders, users and project developers to bring in money, technical knowledge and a location and whose goals are image building or several other self-interests. Now if these parties are communicating, it often happens that they try to convince the

other with their own arguments instead of looking for arguments that are of interest to the other party. Swart (Grontmij): “I have seen a believer talking for half an hour to an involved builder: he had a good story, but it did not come across, as the builder had other goals and these goals were not appealed too.”

This was exactly what I observed on the PAO-course, where after two days the municipalities declared they had not heard a single advantage of alternative sanitation. What they meant was: “not a single reason why it would benefit us too.” Another example is the hammering of wastewater managers on nutrient recycling, whereas stressing the potential advantages for the consumers would have been more fruitful; the success of separate sanitation projects in Germany is due to higher hygiene of these toilets: women like the toilets as it forces men to sit down, doing away with annoying ‘spattering’. (Lems & Geldof, 2004)

It is also very important in a project that there is enough openness, so that underlying worries or interests become clear; when they remain unspoken, they keep frustrating the process. Or like Zeeman (WUR/LeAF) says about the failure of the projects in Emmen and Wageningen: “You never really find out why things go wrong, some things remain unspoken”.

It is being stressed several times, that at the moment very much depends on the right person on the right place – an enthusiastic alderman, innovative water board employee, charismatic director of a housing cooperation. As no general policies are yet in place, nor are their whole organisations interested.

Zeeman (WUR/LeAF) also sees being with too many parties, especially when they are not involved from the beginning, as a factor for failure. On the other hand, Swart (Grontmij) emphasizes the importance of starting off with all the necessary parties from the start, instead of starting only with the ‘easy’ parties’: “when you then invite them later on, do not expect them to feel honoured, in the best case you will have to start the process all over again, in the worst case they will sit back and keep a ‘convince me’-attitude”. Van de Bles (municipality Meppel): “We came in later and I had a lot of trouble finding out what went on, since I was not acquainted with the topic, and what our position could be.”

Swart (Grontmij) is convinced that former projects also failed because they tried to introduce a ‘total-concept’ (from toilet pots to digestion installation), which is hard to oversee and involves too much risk which project developers or housing cooperations are not willing to take. “You should not make the story too complex, and come up with clear goals”.

5.3.5 The non-involvement of the national government

The big absentee in alternative sanitation development is the central government, who does not have any policy on alternative sanitation nor is involved in projects. Indirectly the government (VROM, EZ and C&W) supports innovation through the E.E.T program, but according to Zeeman (WUR/LeAF) they seem not to take notice of what happens within the program. There is no direct contact at all with VROM, DG Water or LNV.

It is true that within VROM and DG Water and their knowledge institute RIZA a lot of scepticism exists concerning new sanitation. This is caused by a lack of a sense of urgency, but also doubt on the real benefits and costs of a new system and the missing of a clear, full picture of the organisation of new sanitation. The general opinion is expressed by Vermij (RIZA): “There is not the idea that we are dealing with what we call a ‘major problem’. Of course this cannot be seen apart from the billion euro infrastructure that is present. For the disconnection of rainwater and for renovation billions of euros are needed again and the expectation is that changes to the system will only bring more costs. Huge investments are only made when you feel that you deal with a major problem and when you are sure that the measures will sort considerable effect.” However, “It has not been proven that source-separation would be more effective, let alone that it would be more cost-efficient. They are still talking

about chances, but the research is still very much focused on the input side (of collection and treatment), but little is known on what happens after collection or treatment and how the concept can be fit in the society. There remain many questions.”

Portegies (DG Water) is somewhat more enthusiastic as she believes new sanitation might form an interesting option in the long run, but also shows how: “You will have to win on costs, cost-efficiency! Since it is very clear that the biggest source of nutrients in the Netherlands is agriculture, there will not be much money available for some extra gain in the margin...”

The split in tasks on wastewater management is also present on national level, causing both VROM and DG Water to believe that ‘actually this is more a theme for the other department’.

5.3.6 *The non-involvement of the nutrient recyclers*

Besides contact with Thermphos there are currently no contacts with the potential demand side for the nutrients, like the artificial fertiliser industry. The solid waste sector is currently not involved either, also not in the DESAR-project Sneek, where in one house organic kitchen waste will be fragmented by a garbage grinder to be co-digested.

Zeeman (WUR/LeAF) says that this has been a conscious decision in DESAR to focus on the technology – whether it is possible to set this up - and not yet on the actual reuse of nutrients. “You cannot do everything at once. And it would involve too many parties”. Swart (Grontmij) declares that making contacts with potentially interested parties for reuse has no priority, “we first have to find out how we get all the urine collected, make struvite out of it – we should not sell the bear before we shoot it”. In Chapter 6.5 we come back to this when talking about the desirability of broadening the transition arena.

5.4 Synthesis with the Actor-Network Theory

In this chapter it has become clear how innovators are indeed acting as ‘engineer-sociologists’, who are not only busy in their laboratories constructing UASB-reactors, managing bacterial processes or calculating nutrient fluxes, but also go out to find resources which allow them to create space for the continuation of their projects. Through *translation* they are trying to build *actor-networks*: heterogeneous networks of aligned interests. We have witnessed examples of successful and flawed translation in the case of alternative sanitation development. In this paragraph we will look at the successfulness (feasibility and viability) of two alternative sanitation projects – the DESAR project and Nonolet in ANT terms. As we have seen in Chapter 2, the successfulness of projects in ANT terms is equal to asking: Did the projects succeed in becoming *obligatory points of passage* between localized and contextualized actors? Did the actors from the *global networks* have an interest in the products and services offered by the projects? Did the innovators effectively mobilize *local networks*, and control the transactions between these networks and the global ones? Did the project acquire *momentum*?³⁴

To provide answers we first need to recapitulate on the character of these local and global networks: of what are they composed? (Verschoor, 1997)

5.4.1. *The DESAR project*

The *global* network for the DESAR-project is formed by:

- the E.E.T-program (EZ, OCenW and VROM) and STOWA offering finance hoping to see the project result in useful innovations stimulating the national economy and improving its environmental performance;

³⁴ For definitions please look back at section 2.4

- the WUR and TU university boards granting finance, laboratories, computers etc. for which they expect that publications are delivered in return;
- administrative bodies that could grant political support to the new sanitation and access of its protagonists to the policy community; municipalities, district water boards, companies etc. offering a place, legal exemptions, finance, technical expertise, services for the pilot projects in expectance of economical returns, prestige etc.

This last group could actually also be regarded part of the *local* network which furthermore is constituted by different types of UASB reactors, fermentation bacteria, vacuum toilets, research texts, pipelines, lab assistants, PhD-students, citizens who will use the toilets, eventually farmers who will recycle the digestate from the reactors etc.

Part of the actors in the global network indeed have an interest in the products offered by the project – otherwise they would not have contributed resources in the first place - however for some parties the interest seems to be very weak or even absent. STOWA and the university boards seem satisfied with the intermediaries delivered to them in the form of publications, symposia, pilot-projects. They have been fully enrolled in the network. However, the administrative bodies, especially the national government and the municipalities seem to have very little interest in the project's products. The national government has granted money to DESAR until August 2007, what happens afterwards is still unknown. More financial resources, let alone political support is not expected for some time to come. DESAR has until now been able to find 'customers' for their production of knowledge, but few 'customers' for their pilot-projects.

The innovators seem to have effectively mobilized local networks when it is about laboratory research, but have failed twice in mobilizing local networks to build pilot-projects, although they are now succeeding in Sneek. There has not yet been any intent to enrol farmers. The DESAR innovators do have succeeded in controlling the transactions between the local and global networks: they have been able to profit from their own efforts. One could say that they have managed to become an *obligatory point of passage* (OPP) for anyone with interest in anaerobic digestion or alternative sanitation. On the other hand, since as we have seen this interest is small, it is a weak OPP. *Translation* was flawed and the translation regime is weak: the project itself has not created any rules of its own which can be successfully added to conventions generally followed: it will not alter the sanitation pattern of people in general, and has not yet been able to change the policy choices or protocols used by water boards or municipalities.

We have seen translation fail for two main reasons. The first is linked to the 'social construction of technology' idea that an inventor not only invents solutions, but also problems; if he/she does not get his problem definition across, there is also no place for his solution. One can see this very clearly for source-separated sanitation: the small interest in source-separated sanitation is not just because it is doubted whether it is a good solution, or because of its high costs, but because a chief part of the influential actors does not share the problem definition of the innovators. Or like Gastkemper (RIONED) says: "The 'trigger' to start the transition is lacking; for the technicians it may be very clear why we should do this, but for the rest of us it is not. For the technicians it is knowledge development and the chance to play with their inventions. But the conditions should force us to change, this can go in two ways: either they show that the new sanitation concepts are even greater and much cheaper (both of which I doubt) or scarcity (of energy/phosphate) and disasters (especially in public health) force change to happen. This is clearly not the case yet." The storyline of some of the inventors about nutrient- and water saving seems unfit for the Dutch situation and leads to similar reaction amongst professionals outside the innovation network and the general public; "Do we not have more than enough water here? Yes, in Africa, there it is a good idea..." and "A manure over-supply, that does not mean we are waiting for more nutrients in Dutch agriculture, does it?". As we have seen, self-referentiality can lead to blocked communication to other parties. However, an inventor needs to be an engineer-sociologist, trying to empathise with the party he/she wants to interest and to emphasize those arguments that are interesting for this specific party. That may lead to

present the issue slightly different: when health, doubling sewage fees, keeping Dutch businesses competitive and climate change reduction seem hot issues for some actors, then do not nag to these actors about nutrients or effluents, but realize that for example “EZ [the Ministry of Economic affairs] is sensitive for what is in it for BV the Netherlands, which chances this can give for the Dutch industry, which market niches and new business activity it may generate”(Portegies, DG Water). It is not just the arguments that count; it is also the language in which they are expressed. In the course of research I have noticed the gap between the innovators language and the modes of working and those of policy workers. Engineers come up with what Portegies (DG Water) names ‘nice loose ideas’ that are interesting for knowledge development and are frustrated when policy makers do not show interest. But policy makers need to be shown a full picture - showing how the technique will be embedded in the existing physical, social and political infrastructure – supported by a cost-benefit analysis. Portegies (DG Water): “With an environmental talk alone you will not make it! You will have to show a sound cost-benefit picture and showing that there is public support for it. Only if you can clearly show that a WWTP will not have to enlarge because of this new sanitation and that therefore the sewage fees can remain the same in a certain area and you can do pilots with which you convince the – excuse my words – conservative water boards, you will get somewhere.”

Secondly, the translation process fails because the other actors - municipalities, VROM, farmers etc. – not only contest the interests attributed to them, but also the definition of their roles. For example in the DESAR-actor-world municipalities have been simplified to equal entities that are co-responsible for wastewater management and that best do so by cooperating in pilot-projects for separate black water treatment. Resistance takes place when a municipality argues that their prime responsibility is the care for the welfare of their citizens and that they feel this is best pursued by investing in for example child care rather than in alternative sanitation. The municipalities’ worries are sometimes not taken seriously; the call to take away the responsibility and mandate over sewerage from the municipalities only aggravates their distrust. Only recognition of the municipalities’ difficult position, in which more tasks have to be realised within a diminishing budget, and of their wider interests (like their care for public order and infrastructure that are affected by sewerage), can lead to an opening of the impasse.

The DESAR-project has gained some *momentum* in a sense. First of all, for the involved researchers, who have specialized themselves in the issue, have put a lot of effort in it and this will for them shape future decisions and limit possibilities outside the chosen track. For the universities as they have invested in educating researchers in the specialization of anaerobic digestion of black water and these sunken investments will make approval of next research proposals on the topic more likely. After the signing of contracts, it will also have gained momentum through the commitment of the parties to the pilot in Sneek. On the other hand, for the national government investments have been relatively low and will not very likely have an effect on future decisions: it is not more unlikely that they will stop the (financial) support to the project altogether than that they continue subsidizing it. If one compares the project’s momentum with the momentum of the sewerage system, one could only speak of an extremely humble success.

5.4.3 The Nonolet project

For the 12 Ambachten with its Nonolet-toilet, the *global* network consists of: donators, administrative bodies granting legal exemption for its systems or certification; SenterNovem and province of Brabant subsidizing research; buyers of the toilets. The *local* network consists of: building materials for the toilet, ventilators; technical employees or an other company assembling the toilets; employees that spread information on the sewerage system and the Nonolet-toilets, aided by leaflets, internet, a room to deliver talks; technicians with the knowledge and skills to install the toilet and ventilation properly;

Orgaworld that processes the dried-in faeces; the bacteria that perform the digestion and composting processes etc.

The 12 Ambachten seems to have been relatively well able to build up this local network, including the processing/reuse side, which DESAR has not yet been able to. It has also been able to enrol several actors from the global network: customers, SenterNovem and the province of Brabant. However it hardly seems to have access to the current policy community, where RIONED, VROM etc are part of. This is not only because of a lack of interest from these global actors in its material product, but also in its image of ‘hippie, tree-hugging, ideological and even sectarian’ club. It has a hard time being taken seriously and therefore to obtain recognition of its products in the form of certification or legal exemptions. According to Leeflang (12 Ambachten) his organisation has often not been able to reap the fruits from its labour; other organisations ‘stole’ its unpatented inventions and the 12 Ambachten has not been granted certification for products it developed. One could thus say it has not been able to establish itself as an OPP. This also becomes clear from its non-invitation to the umbrella organisation for new sanitation by STOWA.

Two factors can facilitate the advancement of the project though: 1) Orgaworld BV is a fast-growing company with a modern, innovative image that might have easier access to the policy making community thus being able to influence regulations with regard to toilet waste collection together with GFT etc. 2) Regulation with regard to toilet waste discharge from ships will become stricter in the upcoming years, creating the perfect niche for Nonolet toilets (it already obtained a HISWA-award in 2004 showing the recognition in the water sport sector). As long as the toilets are regarded as a niche product they will meet with less resistance from the ‘sewerage regime’.

The Nonolet-toilet project does not seem to have reached much momentum: 12 Ambachten has of course invested in the project and trained people for assembling and installation of the toilets, but since it is not a complicated system, these people can easily switch to other projects within the organisation. The subsidies are not of such an amount that they will influence later attribution significantly. For Orgaworld the processing of toilet waste is by no means core business and they have not had to change any of the production processes to perform tests on processing this new waste stream. Where translation has been successful, the translation regime is weak: the project itself has not created any rules of its own which can be successfully added to conventions generally followed: hardly any citizen will consider changing their conventional toilet for a Nonolet and for the present no municipality or project developer will think of delivering a new neighbourhood with Nonolets in all houses or present it as an option to the new inhabitants.

5.5 Conclusions

One cannot speak of one unified network in which all the innovators on alternative sanitation in the Netherlands are included, but different clusters can be distinguished. The biggest cluster in terms of resources and number of actors involved, includes the partners to the DESAR project and Grontmij. They focus mainly on anaerobic digestion and urine separation; they are – through the successful enrolment of STOWA – closest to the water boards and they have a strong believe in a high user’s comfort as a requisite for new sanitation systems. They mainly have a background in wastewater treatment and for them a more effective and/or efficient treatment is the prime advantage of their system, although within WUR and LeAF also the recycling of nutrients and organic matter to the agricultural land is emphasised.

WASTE and the 12 Ambachten see the recycling of toilet waste as important for ecosanitation. Composting is considered a viable option. They have no contact with water boards, but approach municipalities and use their contacts in the organic solid waste sector.

The first group has better been able to establish itself as an obligatory point of passage, although the translation regime is still very weak.

Cooperation within the DESAR/Grontmij/STOWA group is constructive, but with WASTE and the 12 Ambachten cooperation is problematic. Coordination between the different innovator's projects in the Netherlands seems to go well, also because the group is small. STOWA has taken on a coordinator's role and this seems satisfactory to most actors.

Enrolment seems most problematic in case of municipalities, project developers and the national administration³⁵. The division in tasks in wastewater management thwarts the involvement of the municipalities. Solutions seem to lie in stimulating integration through further cooperation, rather than taking away municipalities' mandate over sewerage: threatening with this aggravates distrust and any split-ups will inevitably lead to new problems of policy fragmentation, in this case between sewerage and urban infrastructure planning. Other reasons for flawed translation were the resistance to 'simplification' and the 'self-referentiality' of innovators. The innovators often have difficulty in the role of network-builder. As true 'believers' they use their own arguments and storyline of why their technology should be advanced or tested in a pilot-project, instead of trying to find out for which arguments the other party is sensitive. Besides, the engineers often use a different language than policy makers.

³⁵ The enrolment of citizen-consumers is not analyzed in this research, but might be evenly flawed!

Chapter 6 A transition?

6.1 Introduction

As we have seen in the preceding chapters, there is no consensus on the need for a transition in the handling of black water. Nonetheless, without taking a ‘political stance’ on the issue, looking at the current developments through the ‘spectacles’ of the transition theories can offer us new insights. Therefore in this Chapter, the visions of the actors on the effectuation of a transformation will be combined and compared with the theory on Transition Management as it was presented in Chapter 2. Although the faults of this theory - mainly its determinism - will also become clear (see also 7.3 Discussion), it offers us a useful framework in the analysis.

Firstly (in 6.2), we will look at the changes that would have to take place on the *micro*, *meso* and *macro* level for a transition to occur. Changes not only in the ‘hardware’ of technical infrastructure of pipes and treatment plants, but also in the ‘software’ of the system, involving multiple actors and utilities in the domains of institutions, behaviour, believe systems, culture, economy and policy. We identify both facilitating and impeding factors and trends, and look at where niches can be created for new sanitation concepts. The importance of the creation of niches that are focused (purely) on improvement of cooperation between the wastewater managers or on the role of citizen-consumers, next to the more common technology-focused niches, is emphasised.

Secondly (in 6.3), we look at the phase of the transition and see that even though the alternative sanitation itself is still in a very early stage of development, other changes in water management like the disconnection of rainwater may form the harbinger of radical innovations. How much time will such a transition take and in which phase are we now according to the model?

Then (in 6.4), attention will be focused on the possibilities to steer the developments: Who should take the lead in the transition? What should be the role of water boards, municipalities and the national government agencies?

Finally (in 6.5), the transition arena will be given a closer look, answering the question whether broadening of the arena is desirable and whether there is interest from other parties to enter the arena.

6.2 The levels of the transition

A transition would require the coming together of connected changes in different domains and different levels. Which factors and trends can be distinguished on these levels that could reinforce or weaken the chances for a transition in handling black water?

6.2.1 The macro level of the socio-technical landscape

On the macro level of the *socio-technical landscape*, we find developments that are hardly manageable for the actors on the meso-level and usually change slowly. Some respondents would place the present material infrastructure for wastewater collection and treatment at this landscape level. They see this system of WWTPs and sewers, which has cost billions of euros, as an insurmountable impediment for system change. Others would rather place it on the level of the regime, seeing the indiscriminate lay-out of new parts of the sewage system as a dominant practice rather than an inevitability.

Also the advancement of both ‘alternative’ and ‘conventional’ wastewater treatment techniques over the coming years is a development that is hard to manage for the actors on the meso level, although with subsidy schemes innovation can be stimulated to some extent.

Awareness amongst the general public on issues like the danger of medicine or hormone residues, the importance of environmental protection by reducing nutrient discharges or energy use, but also

cultural definitions of hygiene and comfort, are generally also slow and hardly manageable processes on the macro level. However, crisis might provoke quick change, Gastkemper (RIONED): “If it would become clear today that avian influenza is spread through the sewage system, tomorrow we would all pee in buckets, if so required. Then things can go very rapidly. Public health issues could give an enormous boost to alternative sanitation”. Public awareness is one of the factors determining the political colour of a country’s government which in its turn influences the autonomy of local administrative bodies to involve in experiments and together with factors like economic growth influence the priority for environmental issues in budget repartitioning.

The incentive for new solutions provided by the European WFD is already mentioned and other EU legislation or international conventions like Kyoto might have impact too. Energy recovery is therefore named by Gastkemper (RIONED) as a potential incentive for new sanitation: “I know it is not that much energy, but when municipalities would become enthusiast with the Kyoto protocol...” Rising world energy prices makes energy saving economically more attractive and rising prices for mined phosphate will make the creation of a market for struvite somewhat easier in the long run. For the moment the pressures from the landscape on the regime are not strong enough to create ‘windows of opportunity’: the opportunity for niche-innovations to ‘stir’ something on regime level.

6.2.2 *The meso level of the regime*

On the meso level of the *regime* we find interests, rules, dominant practices and shared assumptions granting the system stability and guiding private action and public policy. In this phase the regime is still an inhibiting factor for alternative sanitation as it is geared towards optimizing rather than transforming the sanitation system: pressures from the landscape or internal pressures (like increasing costs of sewerage and sewage sludge treatment) do not yet lead to such tension that clear windows of opportunity emerge. Like regime-actors (RIONED, RIZA, VROM, the municipalities) said in the last Chapter: the trigger is absent. Lock-in in the current system was named by most participants as the main impediment for a transition, and this lock-in is not just present in the physical infrastructure outlay, but also in what in Chapter 2 were termed the heuristics of the technological paradigm, Swart (Grontmij): “Research in source-separation or scale diminishing of current systems is hardly done. The drive is not there. If one takes a look at AguaTech, one sees a hundred thousand people in hundreds of companies who are looking for new tricks, always on the basis of the conventional system, to comply with the new norms. There are hardly people who sit back to wonder whether the path that we entered on 100 years ago is still the right one, whether it still lead us to where we want to go. This is caused by the human tendency to develop by setting daily steps on the same track.” These heuristics also influence the policymakers and planners, Palsma (STOWA): “The mentality in the Netherlands is to sewerage, unless... whereas in those countries [Sweden and France] the standard is not to sewerage, only if...” This ‘mentality’ has materialized in regulations and fiscal policies that leave little room for other options.

Some believe the inertia is also caused by vested (economic) interests in the current system. Leeftang (12 Ambachten) sees the existence of these interests as the biggest impediment to change and even speaks of a ‘sewage mafia’: “A clique of big building contractors, suppliers of sewerage systems and wastewater systems: the companies presenting themselves at the yearly Aquatech-fair. All their eyes are now focused on the rainwater sewers, which cost billions of euros – investments which might be rendered needless in some places by alternative sanitation – but the companies make big money on it and the municipalities do not care as they receive money for this. The same companies have been selling expensive IBA-systems, denying cheaper, self-regulating helophyte systems that 12 Ambachten developed to the citizens. They obstruct us by criticizing our systems, but at the same time rob our unpatented inventions. And I am sure that municipalities earn on this too, money is passed to them under the table.” Lettinga (LeAF, in: Milieuridders, tv show 09-12-2005) smiling: “Sewage mafia is too big a word, I would just call it ‘the establishment’: a consortium of scientists,

consultancies, companies, people within Rijkswaterstaat etc. who are very hard to convince that we can and should do it differently”. But Martijnse (VROM) - as supposed member of the ‘mafia’ - reacts: “There is a lot of money going round in the sewerage world and companies and consultancies thus have a big interest in trying to keep their business. However, with new developments like these new markets will evolve, like we have seen with the IBAs, and the companies can dive into these markets.” “I do not have the impression that the national government agencies including me, VROM or V&W could be said to be part of a sewerage mafia: we are not obstructing development of alternatives or are principally against it. However, we ask for a thorough story, answering the questions of benefits, costs, giving the full picture.” The involvement of Landustrie in Sneek is a deviation on the micro-level showing that the regime is never quite as unbreakable as it is imagined. This is a company working on conventional water treatment, but sees chances for decentralised sanitation as this might open up foreign markets to their company.

Also our common behavioural patterns around sanitation can be seen as forming part of the regime. The difficulty of changing the behaviour of citizen-consumers, who are used to a very high level of comfort combined with minimum involvement in a highly invisible and professionalized system, is by many respondents seen as a one of the main impediments for a transition in the handling of toilet waste. Gastkemper (RIONED): “For the citizen there is no trigger, because from his point of view the system is working perfectly; you would have to show that for his extra effort he gets something back or introduction will go very slowly”. The ‘flush-and-forget culture’ that exists around our current toilet behaviour, leads to disinterest in new sanitation; it is “a subject that is not being spoken about at all” or only in a “giggling way, giving associations with eco-hippies”.

Both Gastkemper (RIONED) and Vermij (RIZA) point to the fact that the Dutch system of water treatment is a very technocratic, professionalized system, leaving no autonomy to the citizen. Gastkemper: “In the Netherlands the citizen has left all the responsibility in the hands of the government and civil servants have grown to mistrust the citizens. Whereas in Germany, you can buy a do-it-yourself grey water system and install it yourself, here the civil service believes that citizens have too little knowledge to make safe use of such things and therefore impede it. VROM’s decision that second-quality water can only be used in big buildings where re-use is handled professionally is exemplary for this.” But whereas Gastkemper (RIONED) believes that the knowledge of the citizens is underestimated, Vermij (RIZA) states that: “It is not realistic to think that you can put that care duty back with the citizen easily. Then you get stories like that eco-neighbourhood in Utrecht.”

Although the regime at this stage is still mainly inhibiting alternative sanitation, some factors on regime level might (unintentionally) stimulate its development. An example would be the establishment of national policy on hormone disrupting substances or medicine residues in wastewater effluents, not only putting pressure on water boards, but also stimulating innovation in the private sector. Coming to a national agreement on financing arrangements between the municipalities and water boards for rainwater disconnection, would ‘give municipalities faith for later developments like urine separation’, according to van de Bles (Municipality Meppel). The introduction of Waterspoor, establishing a link between wastewater costs and the price of drinking water like is currently done in Germany, can provide a great incentive for new sanitation amongst citizen-consumers.³⁶ Changes in the curriculum of education on wastewater treatment, giving more attention to separation at sources, may lead to the emergence of new heuristics in young scientists.

³⁶ The idea of such a “Waterspoor” has been tried out in the Netherlands in the past, but met with fierce criticism. The wastewater sector is opposed to the idea, since they argue it is not the amount of water, but the amount of waste (COD) that is decisive for the costs of waste water treatment. (Vliet, 2001: 74). Besides most of the costs are due to the high fixed costs, this could result in rising water/litre prices, when people are saving water.

6.2.3 The micro level of niches

On the micro level deviation from the regime can occur. Zeeman (WUR/LeAF) sketches a classical niche management strategy, moving from technological niches to market niches: “First it has to be shown on small-scale that alternative sanitation does work technically. Then that it also is achievable economically: so you would have to upscale the pilot-projects to a scale on which it would be economically viable. Then find the niches, application in favourable situations: where replacement of sewerage is necessary, in the renovation of big buildings etc.” The realization of alternative sanitation projects is most likely on new to build locations. More important than whether it is far from the centres, seems to be whether or not there is already sewerage present.

Localised treatment applications for urine separation could first be targeted at hospitals (including treatment of pharmaceutical residues and hormones), public buildings such as airports, shopping areas, sport stadiums (places with high human “strike rate”) or office buildings (integrating urban irrigation, landscaping and fertilisation). (Wilsenach *et al.*, 2003) In hospitals it is easier to separate streams (partly already takes place), one obtains reasonable volumes and the problem of medicine residues is more acute. Swart (Grontmij) contacted some Dutch hospitals, whose reactions seemed positive. *Niche-cumulation* – the spread of a radical innovation by subsequent application in an increasing number of market niches – could then be a gradual way to make the step from niche to regime level.

Instead of only looking for opportunities where the full concepts can be applied, past experience has shown that radical innovations survive introduction better if they can be used in a *hybrid* form or *add-on* to conventional technology to solve particular bottlenecks. Innovative use of ideas proposed for new systems can then already improve existing systems. According to Wilsenach *et al.*(2003) the immediate benefits of this partial separate urine collection for present wastewater treatment plants can provide a bridge between the existing system and possible future systems, such as complete urine separation. The warning of Palsma (STOWA) for a strategy of environmentally or technologically perfect, but isolated niches also fits well into this theory: “We should join up with existing settings, not stand apart from them creating an island, no Groene Dak rumpus. We should find the overlaps in the circles of interests of the actors, since cooperation and broadening of the development of source-separated sanitation are only progressing, if we can find out where interests meet.” In his description of possible niches, these overlaps in interests are thus essential: “Finding those places where opportunities arise, where things coincide in the local setting: a WWTP that touches its maximum capacity, a municipality that wants to do something or a vulnerable water area that requires more than every effluent quality and money reserved for this and a nature organisation that wants to make the area more attractive for recreation. You have to pick out these places, set up projects there and put the spot light on them.”

A third way in which the step between niche and regime can be made, is the break-through by riding along with the growth in new markets. New markets for decentralized sanitation systems lie in East-European countries and developing countries.³⁷ It is not unthinkable that new systems are first introduced in these countries, before they are introduced on a wider scale in the Dutch context.

Both in the transition literature and by the respondents, technological niches are considered very important for the further development of the technology, learning from the malfunctions that may occur due to for example unexpected use by citizens. They are also important to show to water boards, project developers, municipalities and citizens that new sanitation works: that it does not only deliver benefits to water treatment, but that it functions without nuisance of break-down, odours etc. and to project developers and municipalities that citizens accept the change. Zeeman (WUR/LeAF), Palsma (STOWA) and Swart (Grontmij) all stress the importance of cautiousness, of step-by-step development to take away doubts, thus diminishing risks (whether real or perceived) and creating the

³⁷ Zagt at <http://www.wetsus.nl/nl/congres0705.htm#zagt2> (March, 2006)

crucial societal support. But also to tackle the questions that are still there in try-outs: technical questions, questions of social acceptability and legal, fiscal and administrative questions. For example: If a whole building is disconnected from the sewerage and treats its wastewater locally, then can a discount or exemption on water taxes be obtained and how does the new treatment fit in with administrative/legal responsibilities of the water board and the municipality?

The choice of the first projects can have a fundamental impact, as “failure can discredit alternative sanitation in general and put us ten years back in the process. Therefore the first projects should be set up with almost 100% certainty of technical success.” according to Zeeman (WUR/LeAF). However the other way round is equally possible, “if you can keep the participants enthusiast, they might start to promote their positive experiences to others and even convince municipalities.”

The pilot-projects that are initiated by universities or consultancies usually focus on the introduction of a certain technology in a local setting and niches as the experimentation with different *technological* solutions. But niches can be defined more widely: also the deliberate experimentation with different *social constellations* should be aimed at. As has become clear from Chapter 5, not technological issues but organizational issues, like the cooperation between municipalities and water boards, often form the bottleneck for the development of new sanitation. Therefore, the local experimentation with new forms of consultation, task divisions and financial arrangements between a municipality and the water board can also be seen as niches deserving equal attention.

Also with regard to the role of the citizen-consumer much more could be done in niches. One step is to take account of the reaction of the citizens to the implementation of a new pre-determined technology, but another is to deliberate experiment with giving them more choice in deciding the type of sanitation they get or in allowing them a bigger role in management; for example giving them the option to choose for a concept that asks somewhat more effort, compensated by lower sewage fees. Pilot-projects on sustainable building have often been initiated by citizens, which can have a clear advantage since motivation is higher. Facilitation of these initiatives is important, even when another technique is chosen than is seen as environmentally optimum, as they can give a boost to further innovation. But less motivated citizens should not be left apart, as this would lead to the confirmation of often heard claims that the ‘average citizen is not prepared to change’: the communication to them in expert-initiated pilots should be taken seriously, with different communication strategies tested through monitoring and evaluation.

6.3 Phase and time-frame of the transition

6.3.1 Phase: pre-development or much further ahead?

Assuming that the developments we are now witnessing are part of a *transition in handling toilet waste*, the current phase could be characterized as (the start of) the pre-development phase: a dynamic equilibrium where the status quo does not yet visibly change. The ideas on the new sanitation concepts are still divergent even within the innovation network(s); we cannot yet speak of a more or less consistent emerging paradigm. Swart (Grontmij): “In the next ten years I do not see a clear line coming either, because there are still knowledge gaps. The search for the ideal solution in each situation is still long. And... what is ideal also changes over time.” After a new paradigm has emerged, there will often follow a period of polarization between the existing and emergent paradigm. The take-off phase is marked by the increasing modulation of dynamics within the dominant regime with innovative experiments at the micro level: that is clearly not (yet) the case when we consider handling toilet waste; the actors that are part of the dominant regime (lion’s share of the policy community, of the project developers, of the waste water treatment industries) show little interest, let alone support for the new sanitation concepts.

However, we could come to a rather different conclusion if we were to broaden our image of a *transition, not only focusing on black water, but water management in general*. Because although it is by no way clear that source-separated sanitation will ever be implemented on large scale, it is certain

that because of new pressures on water systems, the visions and practices on how to deal with water have changed substantially over the last decades in the Netherlands. So substantially that can be spoken of a water transition (Brugge *et al.* 2005a): water is no longer seen as an enemy, that we should get rid of as soon as possible, but rather as an ally that should be facilitated. Therefore 'room for rivers' is created and rainwater is disconnected from the sewer and retained as long as possible. This has become official policy on all administrative levels and can thus said to be adopted by the 'regime'. Visible structural change takes place, specific for the *acceleration phase* of a transition. Rainwater disconnection is part of the water transition, but can it said to be the harbinger of an eco-sanitary transition?

In a narrow technological sense disconnection of rainwater cannot be seen as a break-through in the sewage paradigm, as the sewage system is still used to transport all domestic wastewater to large-scale centralised WWTPs. Since eco-sanitation strictly speaking implies a disconnection of all water flows from the sewage system, rainwater disconnection could be seen as a step in the right direction of source-orientation. On the other hand it can be argued that the many investments in a technology that is only a partial solution can be seen as sunk costs that decrease the economic incentive to do new investments in alternative sanitation. (Hegger *et al.* 2005) During the interviews with the municipalities, RIZA and VROM the huge costs of rainwater disconnection were indeed named as a factor inhibiting the interest in new sanitation.

From a socio-cultural view point, rainwater disconnection *is* a step away from the conventional system and a stepping stone for new sanitation: it allows the involved actors to learn about a new regime in which the 'traditional' providers of water technologies co-operate with each other, with actors in the field of urban planning and with citizen-consumers. (Hegger *et al.* 2005) It has already been expressed, that the first is a prerequisite for new sanitation concepts and that learning opportunities are thus more than welcome. But also cooperation of the municipalities with their own urban planners to timely distinguish opportunities for disconnection of rainwater, can lead to an increased awareness of the underground infrastructure and the water system, that will facilitate distinguishing opportunities for new sanitation in the future.

In areas where rainwater is disconnected, the role of the citizen-consumer is no longer a passive one, because its involvement in the how and why of water management becomes a necessity. For the long run (20-50 year) this involvement can lead to a change in the way 'average' citizens look upon wastewater management and increase the acceptability of technologies that require huge change in domestic practices. (Hegger *et al.* 2005)

Only in hindsight we can see whether rainwater disconnection has truly been the beginning of an eco-sanitary transition or one of the final steps in the water transition. Or we could conclude that a transition is on its way in water management, but - like is mostly the case with transitions - that it is difficult to say in which technological systems this will result.

6.3.2 Time-frame of the transition

Very long time frames are named for alternative sanitation to be applied on large scale, mainly due to the sunk investments in the infrastructure of sewerage pipes and WWTPs present. Martijnse (VROM): "It is either going to take a lot of time (50/60 years, waiting for houses and sewerage replacement) to change or a lot of investments." Vermij (RIZA): "The replacement period of the current system is 30/40 years and I think that it would take two or three of such periods". Swart (Grontmij): "Almost everyone in the wastewater sector agrees that if we would have to make the choice again we would – with our current knowledge – never choose for a sewerage system like we have it. The big sunk investments are the problem. It is hard to find out, when/ for how long it is wise to go on the same inefficient path and when to choose a new direction. As long as no new investments in the old system are needed it is best to keep it; with every new investment you have to discuss whether this is still justified." Complicating factor is that new investments will often not be synchronic in time: "In some

places the sewerage has to be replaced in a few years, but then you still have an already built WWTP and houses that are not yet ready for renovation. So then you could put three tubes, but use only one since the other toilets are not yet replaced, and the WWTP is not yet doing anything with the urine either”.

Using the example of rainwater disconnection Swart (Grontmij) illustrates that: “25 years are by no way enough to achieve a transition in black water handling.” “The discussion on rainwater started in 1980, it took 15 years before disconnection of rainwater became policy and from 2000 the first rainwater was disconnected and we are happy if this increases by 1% each year – so the Netherlands will be completely rainwater disconnected in 2200. So when talking about the separation of black water or urine, we should not speak in terms of a few decades. It will probably even take longer as rainwater disconnection since knowledge is still lacking and differing from the case of rainwater, there are very many alternatives. In a slightly negative prognosis, we could be happy if the policy to start implementing urine/black water separation comes into place in 2030”. Van de Bles (Municipality Meppel) does not agree that urine separation would necessarily take as long or longer than the rainwater disconnection. “Putting a third tube for urine would be even easier as you do not need to find infiltration space like with rainwater”.

But also in new building projects, where no infrastructure is present yet, fast introduction will not be the case. If little of the proposals for an emission-free-water chain are included in the final plans for the new to build Meerstad, this is because according to Swart (Grontmij) “It is still too early, there are too many questions left open, about the proper functioning of the techniques in practice, about the costs, about what to do with the urine/faeces, about the implementation. This leads to uncertainty, which means that the risks (for water board, municipality etc.) are seen as too big – and risks cost money.” “Decentralised options are said (by Zeeman (WUR/LeAF)) to have the advantage of flexibility, but in Meerstad we are talking about a huge project. The techniques that we choose now, should also work for the part of the neighbourhood that is realised in 20 years – it is too early, the concepts too little elaborated to conduct a project of this scale.”

In Meppel the first 5800 new houses for the Nieuwveense Landen are due to be delivered in 2008, with building going on until 2030. Swart (Grontmij): “I do not think it is attainable to realise urine diversion there. But we are starting a project with 30 houses in Steenwijk, if this succeeds – and we find an answer to the questions of what to do with the urine! - it will open the way for bigger projects.” Van de Bles (Municipality Meppel): “We are currently working on the town-architectural planning for 2008-2012 and will probably stay with the conventional system for that period; the plan has to be made now and there are still too many open questions also about storage, transport, costs etc. Change will have a chance from 2012 on.” Gastkemper (RIONED): “The separate collection and treatment of black water or urine is no policy in the municipalities or RIONED for at least the upcoming five probably ten years. Fortunately, because the technology is not yet mature. With the minor efforts (in financial terms etc.) that are given to it in the Netherlands I do not see it becoming policy in the next 10 years.”

All of the respondents stress that we are only at the very beginning of developments that may eventually result in a transition. It therefore remains necessary to investigate along several different tracks, Swart (Grontmij): “Research should also be undertaken on for example on smaller MBR-installations and the diminishing the size of conventional system, but this research is hardly done.” And Wilsenach et al. (2003) conclude that: “Sewers may remain an efficient transport method of waste in densely populated urban environments. We expect that in the near future, sewers with centralised treatment plants will still be the most common way of sanitation and waste management. Efforts to improve the system are therefore justified, although this also enforces the system.”

6.4 Managing the transition

6.4.1 Initiating the transition: who takes the lead?

Until now the main initiators of pilot-projects on alternative handling of grey and black water have been citizen groups, (technical) researchers of universities and consultancies. Citizens are named as good initiators of projects as their motivated participation often guarantees success (by Zeeman (WUR/LeAF); Hegger *et al.* 2005) and their projects should therefore be facilitated. However, most of the interviewed feel that since the benefits of a different sanitation system will mainly accrue to the wastewater treatment sector – in the form of more effective and cost-efficient treatment – this sector should take the lead in a possible transition. This is also because they dispose of the necessary knowledge to design the best system. The water boards are named as the ones with the responsibility to take on the role of initiators, with help of STOWA and their Union. Kool (water board Reest & Wieden) and Palsma (STOWA), as representatives of these organisations, agree with this. Palsma believes that the local/regional water managers are the only ones that can effectuate sustainable change in sanitation and wastewater management since “the interest, necessity, knowledge, skills and local anchorage are all in the hands of the water board”. It is their role to initiate the transition, as their power is that they know the local situation, can see ‘where interests overlap’ and can translate policy goals into the adequate means for their specific situation. “If you only look at national level you do not see the opportunities, in national figures the local differences are levelled out in average figures. That is why these developments cannot and should not be (or only slightly be) steered at the national level. Making a big plan on the drawing tables of how sanitation in the Netherlands should look like is not possible, and moreover undesirable. Local situations ask for local solutions, with technologies and alliances that are adapted to the situation. In different areas we have to do with differing water quality criteria, more or less money available, also the agricultural intensity differs by area and the opportunity to reuse nutrients or energy.”

Vermij (RIZA) agrees with Palsma (STOWA), but for another reason: “The water boards should be the ones initiating the transition, if they deem it necessary. Since it is not a major environmental problem, it is not the task of national government. It is more about sustainability step and that means the water boards are responsible for weighing the extra costs against higher environmental returns or implementing lower-cost solutions.”

Zeeman (WUR/LeAF) feels the responsibility of the water boards should be shared with the municipalities. But unsurprisingly, Gastkemper (RIONED) and the municipalities make very clear that no leading role should be expected from them.

An opposing view comes from Swart (Grontmij) who believes that a transition will not come from the water boards and will have to be initiated by national or European government: “the water boards are only executive organisations, they want to be proactive and make policy, but in the end they only have to abide by the norms; once they reached them, they say they have done a good job. So much change cannot be expected from them. They have the responsibility to find out how the current norms are reached cost-efficiently, but then still nothing happens with the hormone and medicine residues. Nor are water boards kept to the Kyoto convention and so digestion is disregarded. VROM should take the lead in setting norms on hormone and medicine residues. This is also important for the private sector’s enthusiasm: innovation only takes place with the right incentive, otherwise one or two pilots will be done, but then it stops.”

The developers of dry toilets – the 12 Ambachten and Orgaworld – do not need the water boards for the implementation of their concepts and they believe VROM should take the leading role rather than the individual municipalities.

It is a debate that is well summarized by Martijnse (VROM) who believes it can be done both ways: *bottom-up* initiative of housing cooperations, municipalities and water boards or *top-down* by the national government. “But then you will have to convince parliament, who will ask for very clear data.

Another possibility is that the market can initiate the transition.” Martijnse himself does not believe that any party has the ‘natural’ responsibility to take on the initiating role.

In evaluation, I believe a combination of bottom-up growing and some top-down steering will be needed to effectuate a transition. Bottom-up growing is essential to create support, new alliances and modes of cooperation and prove the applicability of new sanitation. But some top-down steering (in later phases) could speed up the transition considerably, putting pressure on reluctant or risk-averse actors. As we will see in the next paragraph, in this phase some action from the national government is already desirable to facilitate the bottom-up development.

6.4.2 Type of steering needed

Transition literature can help us to identify possibilities for government guidance, which we will compare with the actors’ own suggestions for measures. As we saw in paragraph 2.4.3 government guidance is by Rotmans *et al.*(2001) seen as most important - although least visible - in the current pre-development phase. Aim should be the promotion of variation by being a catalyst for organizing and stimulating discussions; maintaining a wide playing field, allowing real experimentation and being a facilitator for bottom-up development. Apart from the national government agencies themselves, all of the interviewed would like to see the national government improve its role on these points.

Characteristic of transition management instead of ‘classical policy-making’ is that end goals should not be fixed and be kept intentionally vague: they have the form of a leading principle rather than a technique choice. This goes for the way innovators should manage bottom-up development: a well-thought strategy is necessary, but this should not lead to rigidity. Palsma (STOWA): “We should not start projects haphazardly, as it is also strategic not to do certain projects if technical questions are unsolved. It is important to find out which path you want to follow: where do you want to go, by which steps, how and when to involve which partners, what research or pilots are needed first etc. It is much more about finding this path, and the next steps, then about fixing end goals.”

The same is true for the ‘managing measures’ that are expected from the government. Since there is no consensus yet about the desirable end goal in technology terms, legal prescriptions for a certain technique have no role to play in this phase. None of the interviewed would opt for a legal prescription of urine separation, anaerobic digestion or composting to be installed in new building projects from 2020 on. Only if in the future there would be a 100% certainty that one of these technologies works best in *all cases* (or in clearly defined cases) such a legal prescription could be made, according to the water board and the municipality, but only on request of the water board. Such a prescription could then be used to speed-up implementation or as de Boer (Municipality Meppel) says: “Without such a prescription, implementation will go very slowly, because within a tight budget priority is rather given to other issues.” However, Palsma (STOWA) is against such a technology prescription at all times: “In the Hague they should limit themselves to setting policy goals, not to set policy means, as is now often and erroneously done; like in the case of rainwater disconnection which is turned from a means into a goal.” This is not contradicting with Swart’s (Grontmij) appeal for legislation on hormones and medicine residues; this would stimulate innovation, while leaving open the means to achieve the goal.

Promoting variation by being a catalyst for organizing and stimulating discussions, does not necessarily imply that the government should itself bring parties (physically) together. STOWA is taking on that role and the interviewed seem satisfied with this. However, several interviewed would like to see the national government publicly taking a pro-innovation stance; acknowledging the importance of broad experimenting with both end-of-pipe and separation-at-source concepts to meet future norms. This would facilitate the involvement of water boards, but especially of municipalities – over whom VROM has more authority than STOWA – in the process. Whether it is already time for setting-out a more stringent policy in the field of public health (norms on hormone and medicine

residues) is debated, but pointing to the possibility of future legislation could already have a signalling effect on water boards and the private sector; so that anticipation is considered when investments are made anyhow in the following years. Inclusion of new sanitation in lists of possible future measures to help the achievement of the EU WFD, is also a task for DG Water and the Union of Water boards.

To maintain a wide playing field subsidising research and pilot-projects is necessary and is by all seen as the role of the central government. The private sector is also essential for financing, material, skills and knowledge. However, in this phase, no profit is made on the projects – since on this scale they are not economically viable - and without subsidies pilots will hardly be possible. Several respondents feel that more money from the government would be desirable.

To make room for real and fair experimentation, many respondents come up with the importance of rewarding citizens who implement alternative sanitation by a deduction in the sewage levy – first in individual projects, later possibly in all cases. Municipalities can grant these deductions, but VROM could stimulate the municipalities to do so. It is equally important to keep ensuring legal room for deviations on local scale: the banning of second quality water reuse in households is another step in discouraging citizens to take own responsibility. The same takes place on the level of companies, where regulations often frustrate intentions to reuse waste from other companies as a material into the production process; struvite reuse is only one of the many options that is impeded by such regulations. The collection of dried-in faeces with GFT should be allowed in the areas where Orgaworld works, so that the Nonolet toilet is given the chance to prove itself; having little faith in its diffusion is not a reason to block its progress.

Besides there are several policies measures that can help to achieve generally accepted sustainability goals like energy efficiency and drinking water saving, without choosing the direction of a certain technique. It is then mainly about ‘getting the prices right’. The idea of a “Waterspoor” - the establishment of a link between wastewater costs and the price of drinking water – falls in this category. But also a taxation of artificial fertilisers (for their high energy requirement and exploitation of rock phosphate) is suggested by Jönsson (Agricultural University of Sweden) or the subsidisation of “green fertilisers” by Zeeman (WUR/LeAF).

In later stages of the transition, the role of administrative bodies will change. The Union of Water Boards and the VNG (the municipalities’ union) or even VROM and DG Water will increasingly take over coordination; so that policies can be fine tuned and clarity is given on which policies are in place where. De Boer (Municipality Meppel): “It would also be the task of the water boards to fine tune their policies and the research that they undertake, and of the Union to steer that a bit. With rain disconnection all the boards have different policies and that is annoying for municipalities that fall under more than one water board.” The danger of coordination on higher level can be that it leads to generic solutions for the sake of simplification, ignoring again local differences.

Finally, I would see it as a continuing task of every administrative layer to keep a critical eye at own policies, preventing further lock-in: with every new investment, it should be considered whether this is still contributing to the “right track”, given all the new information. Long-term thinking and overcoming the fragmentation of policy between sectors and departments are therefore keys in managing transitions. Improving integration within the water chain both on local/regional and on national level is essential for any sustainable future: the set-up of Water plans, Wastewater pacts and other integration measures should therefore be encouraged.

6.4.3 A transition policy on sanitation or wastewater management?

Official national transition policies have been started on four themes in the Netherlands, of which the one on sustainable energy provision is furthest on its way. EZ functions as initiator and facilitator, gathering market parties and societal organisations to work towards visions, transition paths and

experiments. Would the start of such a policy be a good idea for sanitation or wastewater management, initiated by VROM or DG Water (V&W)?

Except for Palsma (STOWA), all the interviewed are in principal in favour of such a policy. However, according to several respondents it is still way too early for that. The idea voiced by Swart (Grontmij) that “Ideas are still too wide apart, there is not even a direction yet. There is no agreement – I am not sure either – on whether source-separation or end-of-pipe measures will give the best results” is not a valid argument against the start of a transition policy, as its main characteristic is leaving outcomes open. If a common end goal can be established - like a sanitation system that is energy, resource and cost-efficient, leads to a minimum of emissions, and does not compromise comfort and hygiene – very distinct measures (concepts based on techniques from urine separation to MBR to helophyte filters) can be set out as transition paths. The big advantage of this would be that the current division between the people involved in the development of conventional wastewater technology and those involved in alternatives is bridged: more consultation can lead to more integral solutions and interesting cross-fertilization of ideas.

Nonetheless, there are other, stronger arguments to show that the time is not yet ripe for an official transition policy. Gastkemper (RIONED): “Starting a transition policy like in the energy sector is not yet desirable, as unlike with the energy issue a sense of urgency and necessity for change is lacking. For the moment growing bottom-up is better”. Vermij (RIZA): “It will not be easy to realise that for sanitation. The problem of energy provision is indeed seen as a major problem, affecting both the environment and the economy. When fossil fuels are finished, they are finished; it is as simple as that. There is a strong drive there. It is seen as an unsolvable problem, system changes are needed. The problem of wastewater is not seen like that.”

Within VROM or V&W there is currently no intent to start such a policy, Portegiek (DG Water): “That would be very tough. The paradigm shift that we are trying to realise now is from substances focused/directed to (river) basin directed, looking more at ecology, region-specific measures and diffuse source pollution. I would not know how these alternative sanitation concepts could be included in that...”

In evaluation, it is clear that a transition policy for sanitation is doomed to fail as long as it lacks the commitment of important parties (we will come back to this in the next chapter, when identifying gaps in the transition arena). For the moment, another approach for the proponents of alternative sanitation could be trying to link up with the transition policies that do take place; example would be talking to gas companies to get them interested in involving anaerobic digestion of toilet and kitchen waste as a project within the energy transition.

The facilitator of a possible *future* transition policy on sanitation should remain as neutral as possible, stating the equal importance of innovation in all directions. For an official national transition policy, I believe facilitation by VROM or DG Water seems most adequate, because unlike the Union of Water boards or STOWA they are truly standing ‘above’ all parties; thus having more authority over for example the municipalities, and the possibility of sanctioning parties that are blocking the process.

6.5 The transition arena

6.5.1 An emerging transition arena?

In Chapter 5 we obtained a view into the networks that have established itself around the development of new sanitation concepts. We saw how it consists of a small, but non-unified circle of the innovators or proponents, supplemented by a looser outer circle in which a few water boards and RIONED are present. Can we speak of the emergence of a “transition arena” as it is mentioned in literature? To recall: “a transition arena is best viewed as a virtual arena or network, which provides room for long-term reflection and prolonged experimentation.” (Kemp & Loorbach, 2005) With the establishment of the ONNS-umbrella group (see 5.2.2) such room indeed seems to be created. That it is a small group

at this stage is in line with the literature and defended by some of the involved: Zeeman (WUR/LeAF) names the involvement of too many parties as an obstruction to project advancement and the risk of other people's failing projects discrediting your technologies; Swart (Grontmij) and Palsma (STOWA) feel it is too early to involve more parties, for example in the field of nutrient recycling. Swart states that although for every pilot-project one has to start from scratch in involving the local parties, on the mainlines all the parties are involved and it seems as though the others in the Grontmij/DESAR network agree with him. Outside of that network, another sound is heard as we will see in 6.5.5.

However, three major weak points of the current constellation come up when we look at the requirements of the transition arena in literature. Firstly, a transition-arena, although in its first phase explicitly placed outside the arenas of day-to-day politics and policies, has to be *supported by political or regime-powers* (but not dictated by it!). (Kemp & Loorbach, 2005) Three water boards and the very passive involvement of RIONED are clearly not sufficient to fulfil this requirement.

Secondly, a transition arena needs to consist of people from *different* backgrounds so the transition problem can be discussed *integrally* and *creative, innovative* solutions can be found (Kemp & Loorbach, 2003). Involvement of municipalities or policymakers from the national government may already lead to more integrative and realistic solutions, since these people are more used to think about the integration with urban planning or with other policy fields. However, involving people from outside the regime of the wastewater chain might lead to even more innovative and creative ideas. Especially in this early stage there is a lot to gain from keeping the discussion broad; daring to have brainstorming that involve looking for solutions beyond the own sector and for opportunities to profit from unexpected alliances. Why not involve innovators from other fields like solid waste sector or nutrient recycling sector?³⁸

Thirdly, a transition arena should be an *open and dynamic network in which different perspectives, different agenda's are confronted, discussed and aligned where possible* (Kemp and Loorbach, 2003). In a transition arena for a sustainable wastewater chain, there should thus ideally be included proponents of diverse end-of-pipe solutions, centralized and decentralised options, and separation-at-source options. Now there is a rather firm division between the different sides, which for the moment seems hard to tackle due to the inequality in the sheer number of people and organisations involved, (financial) resources and of having 'proven something' in the past. (Hence, the impeding influence of the regime).

In section 6.5.2 and 6.5.3 we will have a look at the interest from several actors to become (more strongly) involved in new sanitation, in 'entering the arena'. Possible incentives to enter are weighed against knock-offs. Different degrees of action can be expected in different stages.

Then we will in 6.5.4 come back to argue that the circle of those speaking about new sanitation needs to be broadened for it become a true 'transition-arena'.

6.5.2 Interest of the administrative parties to enter the arena

The municipalities show very little interest in entering the arena, since they do not see source-separation of black water as a solution for their priority problems of overflows and high maintenance costs. De Boer (municipality Meppel): "It does not solve overflows, since rainwater is of high volume. If decentralized treatment would require fewer sewers, then maybe the costs for management and maintenance could be lower: but at the moment we are absolutely not considering that – we have no idea." RIONED therefore also keeps a passive role, Gastkemper (RIONED): "I want to keep track of the developments, because it might one day become interesting for some municipalities not to disconnect rainwater, but to disconnect black water. The possibility for cost reductions or municipalities getting really into the climate-policy could be incentives. But it is certainly not a

³⁸ Involvement of other people and organizations may also lead to interesting solutions, but I will not consider them here, as my study has been focused on the solid waste and nutrient recycling sector.

priority for RIONED, as it is not seen as a current need for the municipalities: disconnecting rainwater and sewer maintenance are.”

Gastkemper (RIONED) names two extra reasons for the lack of interest to try out new sanitation concepts amongst its supporters: the resistance against something with an eco-freak (“geiten-wollen-sokken”)-image – “encouraged by organisations like the 12-Ambachten”- and the risk-averseness of both municipalities and water boards. “This fear of risks could also be seen with the introduction of IBA’s: the ‘new technique’ of IBA’s were seen as risky and therefore often the safe route of putting more sewage pipes was chosen, although this was much more expensive.”

How can entrance of municipalities and water boards to the arena be facilitated? Gastkemper (RIONED): “Pioneers are needed who show that it works and that it is better than the current system. On the other hand, the water sector is also very docile: if it would be decided (from upper hand) that we should start to separate black water, it would go very rapidly.”

Gastkemper and Vermij (RIZA) have the idea that interest is equally small amongst the water boards as amongst the municipalities, and “If people in the water boards are interested, I think this will mostly be those of the emission and policy side, not the people that work on the techniques of wastewater treatment.” However this is contradicted by the latest developments, Palsma (STOWA): “That initiatives from water boards do not come spontaneously, does not mean that they are not interested or prepared to think about separated sanitation, but for them it was not concrete enough: they do not dare to take the step as they do not see how to. With respect to this, the ‘NP’ project in Meppel has been a true trigger, now there are water boards that spontaneously call to STOWA that they want to do something alike or at least are interested.”

On the national level, little interest in entering the arena exists within RIZA and VROM. Vermij (RIZA): “For the moment, we do not want to get further involved; we are kept informed, STOWA is already getting parties together and forming visions adequately. If the water boards and municipalities are convinced, they will let us know. But you should not expect any form of action from the national government for a long time to come.” “For RIZA goes, that if we notice interesting developments, we are there to bring this under the attention of policy makers. We are not in the stage yet, that we would give off these signals”.

Martijnse (VROM): “First go on experimenting and think about proposals. Then when you have got the picture round, or a little bit before that, you can approach the national administration.”

On the contrary, DG Water is not kept informed nor invited to symposia or discussions and Portegies (DG Water) finds that a pity: she would like to be added to the network, to receive both technical and other concrete data on the different sanitation concepts, so that the developments can be followed with an eye on long-term policy visions. “DG Water or I myself could also play a role in getting parties and experts together, organizing discussions, but then we first need to be informed well with a thorough story, since I do have a lot of questions and doubts about it. I am part of a work group with VROM, VNG, STOWA, RIZA and the water boards in which we try to deliver a framework on the basis of which water boards can come to a weighing of the different measures with which they can meet the EU WFD requirements. Now would really be the time to present alternatives. However, these far-reaching techniques are looked upon as visionary. We are definitely open to them, but the new standards have to be realised by 2015, so we have to look to the present and these techniques will take a long time before they are fully developed.”

6.5.3 Interest of nutrient and organic matter recyclers to enter the arena

With the exception of Amfert, the phosphate processing industry has actually very little interest to enter the transition arena. Thermphos would certainly not take a leading role in the transition, but would be willing to participate in talking about it as it is already doing. They want to play a pioneer role in convincing others of the importance of phosphate recovery, by sharing their knowledge in this

field, especially with dung processors and wastewater treaters. Thermphos would certainly not be the one to *initiate* a pilot-project on urine separation or collect the urine from houses. Schipper stresses that this is the responsibility of the sanitation-people, who can then deliver the dry material to Thermphos: ‘we are no water treatment plant’. And to *participate* in a pilot-project on urine separation? “Well I would say, sent us some samples.”

DSM Agro is not at all interested in participation research or pilots for reuse: “That would more likely have to take place at the sector that supplies us.”

Zuid-Chemie has only little incentive: “If the regulation allows it [they have become very discouraged due to regulatory problems with earlier recycling projects] and it is economically feasible we would be interested in a pilot-project for struvite use. If it is not cheaper than the regular source, it should be subsidised. We will not undertake deep-digging research, nor take the initiative. Financial support and initiative should come from the side where the problem exists [the wastewater sector].”

Competitor Amfert Fertilisers BV say they would be (very) willing to cooperate in a pilot project on the recycling of struvite out of human urine. “As long as we do not suffer financially we are willing to cooperate with any project for nutrient recycling” “At the moment it is still about investments, in the future we can be ahead of the competitors, as we are in the special position that we can process struvite”.

The difference in readiness to enter the arena between Amfert on the one hand and Zuid-Chemie and DSM-AGRO on the other hand, is explained by Wille (Zuid-Chemie): “Amfert is a different company; they are owned by an Israelian business group that is also supplier of raw phosphate and kali. We are not involved in the mining; we could be Amfert’s customer for the primary product. Therefore recycling for us is interesting when it is cheaper – but with good quality - than buying minerals from such a company. But for them it is a more direct threat: the recycled products would compete with their raw minerals. Since it is a more direct threat, they rather incorporate that development into their own company.”

Stichting Mestverwerking Gelderland might be interested in participating in a work group on exploring new markets for struvite: “Please, give us a call if such a group is assembled, then I will propose participation to my colleagues.”

LTO’s initial reaction on recycling of (nutrients out of) toilet waste is negative and translates as “We already have (too) much animal manure to cope with and if an artificial fertiliser substitute will be developed, why not out of animal manure?”. However, when the potential contribution of new sanitation concepts to achievement of the EU FDW is explained, involvement of LTO suddenly becomes interesting. Heijmans (LTO) imagines a ‘tit for tat’ negotiation about each sector’s contribution to achievement of the FDW norms: farmers using the recycled toilet waste in exchange for less extra nutrient norms?” If the idea of recycling is considered seriously, then the agricultural sector should be involved in an early phase: individual farmers for pilot-projects on struvite use; LTO can be approached with a clear story, placing it in the bigger context of water quality as a common problem, showing that this can be one of the solutions in the long run. If a picture of the societal and sectors’ costs and benefits can be shown, there will be interest at LTO according to Heijmans.

In the solid waste sector only Orgaworld seems interested. Kaskens from Orgaworld (Geurts, 2003): “For us the interest is small, so we will not do much for it. The government should develop a long-term vision. We want to innovate, that is business. For experiments subsidies would be desirable. When you speak about big volumes, it is normal business. But we would not take in waste that is not being paid for.” In 2005, Van Bomen (Orgaworld): “The demand for compost has risen substantially, so we are really interested in more quantities of organic waste like toilet waste. We will work on pressing the government to change the policy so that it could be collected with GFT [organic kitchen and yard waste]”. And “we could help a little to think about which ways of collection is best - via

vacuum pipes or GFT – but that is not our business, it would be better to ask the collection and transport sector.”

So, in sum: spontaneous entering the arena of all of the parties is not to be expected. They will not take initiative and when approached, will only enter if their specific conditions are met.

6.5.4 Analysing the chances for broadening the transition arena

Broadening the arena with regime and political powers

Coming back to the first weak point, that the emerging arena is too little supported by regime or political powers, I plead for increased attention to the participation of municipalities. Involvement from this early stage on can enhance the chances for successful diffusion of new sanitation systems in later phases considerably. As we have seen, municipalities are not only needed for legal approval of building new sanitation and for embedding these deviations into the existing physical system, they are also needed if one wants to experiment with discounts or exemption on sewage fees.

In Chapter 5 it became clear that municipalities feel resentment for having been left out in the policy development phase over several water management issues (like rainwater disconnection, establishment of norms on the basis of the EU WFD and the guidelines for terminating discharges in rural areas) in the past, for which they bare major part of the costs of implementation. This feeling obstructs fluid implementation of these measures and needs to be tackled for future innovation, like new sanitation systems, to have a chance. To get municipalities to regard themselves as ‘co-problem-owner’, can only be achieved by early participation. In Chapter 5.2.4 Swart (Grontmij) warned for the pitfall of starting off a project with only the easy parties and leaving the invitation of more difficult, but equally necessary parties to the end (“at best you will have to start the process all over again, in the worst case they will sit back and keep a ‘convince me’-attitude”): I believe that what goes for a project also goes for the overall process. If involvement proves difficult, this is a reason to increase efforts, not to give in.

If it is not yet possible to involve VNG at this point, it would be good to at least keep municipalities that already participated in pilots or are about to do so more involved also in the wider discussion, preferably as part of the umbrella group. Stimulating the municipalities to bring in their specific concerns so that these receive extra attention is essential to create more openness and commitment. Helping them in defining their position by showing the concrete options they have to play a role. The sharing of good experiences from municipalities with their peers can prove helpful in drawing new municipalities over the line. It is an erroneous idea that this will evolve autonomously; facilitation of these processes is indispensable. And as also became clear in Chapter 5: “believers” and engineers are often not the best people to take on the task of communicator and facilitator of communication: for these tasks people having knowledge, skills and experience in project management with municipalities and other societal or institutional actors should be attracted. Especially now that the circle is widening, this project and contact management is not something one can do as a side-job, it is a task deserving full attention and recognition; something that is in my view not sufficiently realized.³⁹

³⁹ This links up with Shove’s (1998) research on the still prevailing perception amongst engineers and policy makers of technology transfer as a process of overcoming ‘*non technical barriers*’ – mainly market failure and psychological factors such as ignorance, apathy, traditionalism or lack of political will - which inhibit the realisation of *proven technical potential*. This strong conceptual separation between the realm of the technical and the realm of the social places technical researches in an especially privileged position: it is they who define the technical fixes upon which environmental efficiency depends. Sociologists, economists and market analysts are then charged with the secondary tasks of removing blockages and easing channels of communication so as to allow proven technologies to flow unhindered into everyday practice. These ‘non-technical’ jobs are generally defined and specified by project officers equipped with a background in engineering and an understanding of

It should be realized that processes of change in the mindset and practices of social actors are often slow. The function of a transition-arena is explicitly not just to provide a space for the pure technological development, but also to provide a “space” in which “each actor should redefine their own role, their competences and their *modus operandi* in interaction and co-production with the other actors. Through such a process of co-production and co-ordination, actors at different levels will be able to formulate joint goals and develop common strategies that involve societal uncertainties, power-relations, institutional barriers as well as ambitions, targets and desires.” (Kemp & Loorbach, 2005)

In this stage there is little interest from national government to become highly involved. This is not yet indispensable for the moment either, but will be in later stages, when national approval or guidelines can speed up the transition and when lower-level coordination becomes increasingly difficult because more parties get involved. To prepare a stronger involvement in later stages, for now it is important to keep national government well informed. Since they are working on long-term visions, on-time adequate information about new options can prevent lock-in through a timely change in the direction of investments. RIZA and VROM feel that they are sufficiently informed and involved for the moment. Nonetheless, they also express that more concrete information is still lacking on costs, benefits, embedding in the current infrastructure and the after-treatment route for urine and faeces: more research is necessary on these issues. An opportunity is DG Water: although critical, they are open and currently not kept informed.

Diversifying the arena with nutrient and organic matter recyclers

I do not agree with the idea that since not recycling, but the collection of faeces and urine, will be the bottleneck (like Palsma (STOWA) states), the issue of recycling can be left to the very end. Answering or at least starting to answer the question of what we are going to do with separated urine and faeces is essential in the coming period and is backed by experiences in Sweden and Germany and brought forward by Jönsson (Agricultural University of Sweden), 12 Ambachten, WASTE, van Dijk (NMI), van Veen (Stichting Mestverwerking Gelderland), Heijmans (ZLTO) and Kool (Waterschap Reest & Wieden). Jönsson warns for making the same mistakes as in the Swedish and German situation where problems are now occurring with the outlet of the separated urine and compost. “The problem is that they did not involve agriculture at an early stage. Then you would also know the requirements of your end-product: is digestion/ composting needed or is heating enough. That has implications for the techniques you use in your pilots.” Not only will answering the question have impact on the direction of developments in terms of technique choice – determining which technique will ‘win’ in which situation. Good answers will also help to take away the obstacle that the problem definition (importance of nutrient recycling or recovery) of part of the technicians is not understood/ shared; if good opportunities for recycling are found, this will add force to the argument and if not, the argument should be dropped. It will also help to take away doubts from water boards and RIZA (“they only talk about the input side, not about what’s happening next”) by getting the picture clearer.

Debatable is of course, whether more parties need to be involved to answer the questions at hand. The agricultural sector generally is perceived as having little interest in getting involved at this point, nor are Thermphos, Zuid-Chemie or DSM-AGRO. Two parties that are interested are Orgaworld and Amfert. The requirements that these companies are posing for taking in toilet waste or struvite, can have considerable influence on the choice of the most adequate technology and scale on which treatment should take place (de- or centralized). Their interest also influences the costs of the system (f.e., if no-one is interested in the sludge from anaerobic digestion for recycling, then a more

social science mediated by popular images of market research and by psychological theories of ‘what make people tick’. (Shove, 1998)

expensive disposal route will have to be considered). Besides, involving these actors in setting-up the research agenda can improve the practical utility of the research undertaken.

Of course there is also a possibility that new businesses will fill up the gap and create a new market for the products made from toilet waste. However, this will be hard: there are little incentives as nearly no profits are expected from the sale of the products, only from the waste processing.

Anyhow, I would like to link up with the warning by van Veen (Stichting Mestverwerking Gelderland), who has been involved in finding a market for struvite coming from calf's slurry: It is a very long trajectory to find or create a market, finding parties that are interested, getting your product tested and categorized according to the fertiliser regulations, applying for exemptions etc. It would be best to start exploring in an early stage. "I would say doing one pilot-project on how to make the struvite product, but then first priority should be to organize the outlet".

One could choose first to study other things like citizen acceptance of urine diverting toilets, but – and this would be my critique on the Meppel pilot – acceptance does not only depend on the comfort or looks of the toilet pot, but also on the story behind it; if citizens are really convinced of the usefulness, they will easier accept changing their practices, but if doubt about the utility sneaks in, motivation may be lost instantly.⁴⁰ As long as this story is not clear, it is also quite hard to test 'acceptance'.

Another sector that could be involved when digestion is considered, are the energy companies. Kirsten Zagt (DESAH BV)⁴¹ suggested that it would be good to involve people from the energy sector, since they might be easier to enthusiasmize than municipalities. Through the focus on energy use reduction, you could come to another representation of the issue and thereby attract more people. This is debated by Zeeman (WUR/LeAF) who sees energy generation only as an extra, which cannot be presented as a big chance.

Of course, the preceding does by no way imply a lesser importance of companies within the wastewater sector. I think inclusion of a company like Landustrie is a big gain. However, as has been ascertained, the lion's share of the wastewater treatment companies is – as part of the regime - focused on solutions in the conventional direction. Therefore involving other companies might be both refreshing and necessary.

6.6 Conclusions

6.6.1 Impediments, chances and phase of the transition

The main impediments for a transition in black water handling are:

- lock-in because of the huge sunk investments in current infrastructure and heuristics of policymakers and engineers;
- the lack of a sense of urgency amongst some key actors, most pronounced amongst RIZA, VROM, RIONED and the municipalities;
- the complexity of changing citizens' behaviour in a technocratic, professionalized system that combines a high comfort level with extremely little involvement of the citizen;
- the many questions that are still open about costs, benefits and the further processing of the urine/faeces.

⁴⁰ Separation at source of solid waste in the Netherlands is a good example of this: a major part of the Dutch citizen's have been willing to make the extra efforts to separate their waste without financial or other benefits to themselves, just because they are convinced of the societal utility. However, the rumour that the separated waste later on ends up on the same heap again, is often sited as a reason for disappointment and giving up the environmental friendly behaviour.

⁴¹ Source: interview with Palsma (STOWA)

The strong vested interests of companies supplying elements of the conventional sewerage system and the inflexibility of current regulations on reuse are also named by some as impediments.

There are also developments taking place that can facilitate a transition in black-water handling, mainly: the strengthening of water quality standards through the EU WFD; the increasing importance of energy saving and recovery; and increased worry about the effects of hormones and medicine residues. However, a true trigger to pressurize the regime is still lacking! This might either be formed by crisis or by a slow bottom-up ‘showing-that-it-works’-strategy.

Pilot-projects are still predominantly seen as real world test-cases for technologies, but since institutional and socio-cultural circumstances are identified as major bottlenecks for a transition, the selection or creation and carefully monitoring of socio-technical niches should be regarded equally important.

If a transition towards new, more sustainable manners of handling toilet waste would take place, the current phase could be described as pre- or even pre-predevelopment, since there is no consensus on an emerging paradigm or any change in the status quo. However, grey and eventually black water disconnection might also be seen as possible future part of the ‘water transition’ currently taking place. Rainwater disconnection can be treated as a potential stepping stone for more radical innovations, since it gives opportunities to improve cooperation between municipalities and water boards, and between municipalities and their own urban planning people. Furthermore, it implies an increased involvement of citizen-consumers in water management, which may in the long run lead to acceptance of more innovations demanding more drastic change in practices, like grey or black water separation.

For a transition in black water handling, long time frames are envisaged, due to sunken investments and high (perceived) risks because of remaining open questions.

6.6.2 Managing the transition

Although citizens are seen as successful initiators of pilots, water boards are seen as the ones responsible and best equipped to take the lead in a transition. Doubt is expressed on whether these will take on this role without pressure from stronger EU or national norms in the field of medicine and hormone residues. Also the private sector is expected to move little without the incentive of norms.

In the current phase national government should mainly take on the role of facilitator of bottom-up initiative; at the moment this is not done sufficiently. In the coming period continued funding is not enough anymore to create room for experimentation; legal room should be guaranteed and discounts or exemptions in sewage fees made possible. This can first be realised in local try-outs, but VROM should stimulate municipalities and provinces to grant the exemptions.

The time is not yet ripe for an official transition policy, as the need for structural change is contested: the current situation is not seen as highly problematic, and a sense of urgency is lacking among important actors – therefore a good basis, the commitment to a process of joint learning is lacking.

6.6.3 Broadening the transition arena

Comparing the current networks around the development of new sanitation concepts with the literature concept of “transition arena”, two weak points of the current constellation are: the lack of support by political or regime-powers and the rather uniform back-ground of the involved. This leads to three recommendations to the proponents of alternative sanitation. Firstly, to extend efforts to involve municipalities from the very start. Facilitation of their participation should be taken more seriously, since we are not talking about a mere obstacle, but as a fundamental part of a socio-technical solution. Secondly, should national government perform its role of facilitator better in next stages, then preparation through good information-delivery is necessary now and should be increased towards DG Water. Lastly, it is recommended to start the involvement of nutrient and organic matter recyclers in the short term, since exploration of markets will be a long and hard trajectory. This is mainly due to

the low interest from existing companies. Finding answers on what to do with the toilet waste is not only vital to prevent later problems with outlet like in Sweden and Germany, but also to close the loop in the storyline of new sanitation.

Chapter 7 Conclusions, discussion and recommendations

7.1 Introduction

In this chapter conclusions and recommendations are made on the basis of the empirical and theoretical findings. The conclusions start with a note on the role of ‘technological’ and ‘sociological’ factors in the case of alternative sanitation. Then answers to the research questions are formulated: a picture of the actor-networks making up the transition arena is sketched and the chances for a transition in black water handling evaluated. The phase of the developments is characterized and possibilities for steering dealt with. Special attention is paid to the place of toilet waste recycling in the development of alternative sanitation.

In the discussion the value of the theoretical framework for this and future research is assessed.

On the basis of conclusions and discussion, recommendations are drawn. Firstly, recommendations are made on the use of niche-management in Transition Management. Secondly, recommendations to the proponents of new sanitation are made to improve their network-building capacities. Thirdly, recommendations to the government and their advising bodies are made.

7.2 Conclusions

7.2.1 Dissolving the technology/ sociology divide in new sanitation

The case of eco-sanitation in the Netherlands is illustrative in showing that successful technology implementation only depends for a very small bit on developing a “technologically perfect” artefact in a laboratory. It is of little use to define a ‘technological potential’ for eco-sanitation that is obstructed by ‘non-technical’ barriers (Shove, 1998). Hence, should we talk of technological or a social problem when: citizens’ acceptance of new toilets is affected, due to the fact that they oblige men to sit down to pee/ produce odours/ increase dependence between neighbours⁴²? What is environmentally optimum does at the end of the day, not depend on the highest energy or water efficiency measured in the laboratory, but on whether or not the technology can actually produce a saving in the real world. This depends on the feasibility of implementation and of use, determined by whether or not it fits in with existing material and non-material infrastructure. Conclusion of this research is that the key bottlenecks for alternative sanitation clearly do not lie in the laboratory stage, but in its societal embedding, in its “transfer” to society. The perception of technology transfer as a one-way, linear process itself is flawed, but proves persistent and so does the rather simplistic view on social ‘barriers’. The idea lingers amongst engineers that interest in their technology is only blocked by psychological factors like ignorance, lack of political will and by market failure, without acknowledging that it can be perfectly rational of actors within their context not to be interested in new sanitation.

We have seen how evening the strong dissection between the ‘technological’ and the ‘social’, can offer us much more insight. Successful socio-technological development is then seen as a process of co-development, in which problem definition and solutions are both constructed along the way. Actor-Network Theory has helped us to identify important reasons for the difficult enrolment of new actors: self-referentiality of the proponents of new sanitation and resistance by the new actors to the simplification of their and society’s interests by the proponents. Transition theory helped us to identify the impeding influence of the current regime on change and developments on different levels that can aid a transition.

⁴² When the vacuum in your toilet fails, because the neighbour’s valve is blocked.

7.2.2 Describing the transition arena

In answer to the first research question *Which actors comprise the potential transition arena around managing toilet waste in the Netherlands and what is their current involvement in eco-sanitation; what relations do they have with the other actors; and which views do they have on black water treatment (current and alternative)?* the following can be concluded. The circle of those involved in the development or propagation of new sanitation is small and divided. Differences exist between the “radical believers” (WASTE, 12 Ambachten, WUR environmental technology department, LeAF) and the more “pragmatic proponents” (Grontmij, STOWA and TU Delft) of alternative sanitation. Dispute exists over the choice of techniques (composting, anaerobic digestion and urine separation), over strategies and over the role of the citizen-consumer. Part of the proponents sees the reuse of nutrients and organic matter as essential to eco-sanitation, while the other part focuses mainly on improving wastewater treatment. Cooperation is poor between WASTE, 12 Ambachten and the rest of the innovators. Nonetheless, by outsiders little distinction is made between the groups and their proposals. Cooperation and coordination seem to go well between the partners to the DESAR project, STOWA and Grontmij. This cluster has been able to establish itself as an obligatory point of passage, although a weak one. Through STOWA they have good openings towards the water boards and STOWA’s presence also facilitates contact with other members of the current policy community. Nonetheless, within the policy community appreciation of new sanitation is problematic and ranges from tentative enthusiasm by a few water boards, to neutrality and scepticism of different degrees within other water boards, RIONED, RIZA, VROM and DG Water and rejection by many municipalities. Support or interest for new sanitation still hinges on the presence of one or two enthusiastic persons within an organisation rather than a general approval of the whole organisation.

When we would regard the network(s) around new sanitation as an emerging transition arena, we notice three weak points. Firstly, the rather firm divide between the organisations and people working on system change (on alternative sanitation) and those following the more conventional track of system optimization. Secondly, the lack of support from political or regime-powers. Thirdly, the rather uniform background of the involved: all those in the DESAR/Grontmij/STOWA cluster are coming from the wastewater chain, while for system innovation new alliances with nutrient recyclers or energy companies could be equally interesting.

7.2.3 Impediments and chances for a transition

The following can be concluded in response to the second research question *What are the visions of the actors in the potential transition arena on effectuating a sanitation transition – away from the sewerage system towards eco-sanitary ways of managing toilet waste - in the NL?* There are several developments that can aid a transition towards source-separation, like the more stringent EU WFD standards and increased attention for energy saving and the risk of hormone and medicine residues, but for the moment a real trigger is absent. Outside the small circle of believers the current sanitation and wastewater treatment situation is not viewed as really problematic – the problem definition of the believers is not understood nor shared - and there is a strong belief that the system can be improved through optimization rather than system change. This cannot be seen apart from other factors inhibiting a transition, of which the lock-in through sunken investments in current infrastructure is seen as most important. Other impediments are: regime factors like the heuristics that guide research and policy; the fragmentation in policy between transport and treatment of wastewater due to current divisions in institutional tasks; the socio-cultural robustness of sanitation practices and vested economical interests. A trigger could speed up the transition considerably and could take the form of for example: a crisis in public health, extreme phosphate or energy scarcities, but also concrete figures showing significant cost reductions. Without such a trigger, a long, bottom-up trajectory should be expected; with new sanitation growing through niche-cumulation or via add-on to improve bottlenecks in existing techniques.

7.2.4 Transition phase and uncertainty

Separate collection and treatment of black water could be envisaged as a future part of the water transition, which is currently on the way. Indeed, rainwater disconnection has opened the road to source-orientation, increased cooperation in the wastewater chain and an increased involvement of citizen-consumers. However, when looking at black water handling on its own, the current phase can better be described as pre-development: no change to status quo can be noticed and there is no consensus on an emerging paradigm. Uncertainty is a key word in characterizing the current situation. There is no agreement on which sanitation concept is best in which situation; whether a decentralized or centralized system would be best; little idea about whom should take on which task in a new system (municipalities, water boards or third parties); no answer to the question of what will happen to the faeces and urine once separated or digested; no neat overview of costs and benefits. Niches are vital in getting clarity on these issues, since most of it cannot be reasoned from behind a desk. However, innovators seem to define niches too much as only real-world test cases for technologies, ignoring or underestimating the importance of learning about diverse social constellations through deliberate experimentation with them.

7.2.5 The role of government in managing the transition

When looking at the steering options different governments have during the transition, we conclude that the central government should in this phase take on the role of facilitator of bottom-up developments, by securing room for experimentation, stimulating innovation and maintaining a wide playing field. Whether top-down steering – in the form of standards on hormones and residues or in a much later phase national guidelines on sanitation - is required is debated. Such top-down steering could accelerate a transition considerably. On the other hand, it is emphasised that future guidelines should leave ample room for local diversity and define goals rather than the means (the means being a certain technology). Most respondents therefore see water boards as the adequate bodies for defining policies in close cooperation with the municipalities and for taking the lead in a transition, since: water boards are expected to gain most from new sanitation and they dispose of the knowledge on the local situation.

7.2.6 Recycling toilet waste as missing link

Part of this research was dedicated towards the recycling of nutrient and/or organic matter coming from toilet waste, which is explicitly propagated by part of the proponents of alternative sanitation. Moreover all actors studied, agree that finding out what to do with the urine and faeces after separation is essential for the further development of new sanitation. Hence exploration of reuse as one of the options for getting rid of the toilet waste is useful. Nonetheless, hardly any consultation takes place between the innovators and potential reusers, except for the 12 Ambachten who collaborates with Orgaworld and the participation of Thermphos to Wetsus. There is no interest in urine as a fertilizer and there is hardly any demand for struvite: farmers are not interested in the raw struvite, Thermphos does not want it and neither does the artificial fertiliser industry, except for Amfert (but they require high volumes). There seems to be a more promising demand for a compost product with enduring organic matter and low nutrient content. However, it is doubted whether this can be produced from faeces and organic kitchen waste in a cost-effective way without compromising user's comfort through the use of dry toilets.

7.3 Discussion on the used theories

Actor-network theory and transition management have complemented each other in this research to come to a useful analysis. ANT has been useful for the analysis of technology development as actors' intents to pursue their own project by building networks and gives therefore ample space to investigate

the role of individual actors and agency, something that clearly lacks in transition management. However, ANT gives little overview of bigger trends, for which transition theories are useful. It could even be accused of ‘empiricism’: offering mainly descriptive work and post-hoc explanations. ANT would be poorly equipped to explain particular developments, since it leaves behind all a priori assumptions that are made in existing social theory; assumptions on the nature and influence of pre-existing, large-scale social structures (such as class and markets) and in particular the a priori attribution of social interests. To its critics, ANT runs the risk of ceding too much power and autonomy to individual actors, rather than to existing structures of power and interests. (Williams and Edge, 1996) In our case this would be that too much power or room of manoeuvre is assigned to the innovators in their network-building. However the recommendations that will be made in this report, are not based on the idea that they have so much influence on the outcome of developments that changing their communication or actions could bring about a transition. Rather they are based on the idea that the room they *do* have, should be used as best as possible, thus making chances for a transition a little bigger. Moreover, the advantages of the ANT approach should not be underestimated: by not making a priori distinctions (in ‘the social’ and ‘the technological’ nor assumptions on power relations or impeding structural factors) it has offered a more open view on what is actually happening in this specific case. Besides, seeing scientists and engineers as any other societal actor that tries to pursue its project, proves more realistic than seeing them as a category apart, led by internal logic or the ideal of a selfless search for wisdom for the benefit of society. Of course, the advocates of alternative sanitation are striving to a more sustainable society; however the wish to advance their own project and get the credits for that is just as important.

An open view resulting in a clear picture of the situation at hand, opens the way for creative recommendations. ANT is more a methodology for arriving to this picture, rather than giving further suggestions for improvement or government steering. This is exactly what transition management does try to do; often successfully, but sometimes falling into the pitfall of becoming a rather deterministic framework. An example of its determinism can be found in its description of the transition arena, which gives a chronological order in which firstly innovators and strategic thinkers define transition goals, then less strategically oriented actors are included to set out transition paths and finally more operationally oriented actors are involved in setting up experiments. The real world practice is not quite as neat as the theory and this will not be confined to my case. Of course, in my case we are not witnessing a formal transition policy process, but it seems a rigid and rather unrealistic view of how such a policy comes about or should come about. Little is said on how the initial group is selected: ‘out of the blue’ comes a group of innovators and strategic thinkers that makes visions. In my case pilot-projects are already started before there is consensus on the vision or transition goals and operational people are already involved as they are needed to build-up these projects. This has to do with the fact that the issue is still not generally accepted as a major problem or the new sanitation concepts as viable options: pilot-projects are thus initiated to prove the utility of these concepts and attract new actors, whose involvement will in the longer run be essential, to the transition arena. It is not unlikely, that more transitions will have started in such a way. Moreover, such a bottom-up approach – even though born out of necessity – may facilitate diffusion of the technology in a later stage: by incorporating the needs and knowledge of lower level actors better.

More empirical research may nuance the deterministic nature of the transition theories by showing the different pathways by which transitions may occur. Most studies that have been undertaken on transitions are done in hindsight. This report shows that the theories can also be a useful framework for ex-ante studies.

The idea that both in the case of new sanitation-development, but also in Transition Management theory itself, niches are still too much defined in technological terms is subject of my first recommendation in the next section.

7.4 Recommendations

7.4.1 Recommendations with respect to transition management

It is now generally accepted (in literature on technology development, but also by engineers themselves) that technologies need to be tested in real-life niches, to identify any problems that were not anticipated in thought-experiments. However, the idea that also policy measures or deviant institutional or social constellations can and should be tested is largely ignored: the false idea that what ‘the’ citizens want or how citizens will react can be predicted from behind a drawing table turns out to be remarkably resistant.

Now often the technology is taken as a starting point for niches/ pilots, but one can also set-up niches differently, starting the other way round: for example by selecting or creating different forms of cooperation between water boards and municipalities and monitoring and evaluating these. Another option would be to begin a pilot by starting from a water board and a municipality that already have a good relationship and who are open to do something innovative. Helping them in the process of finding out what could be interesting in their case – grey water recycling, urine separation or digestion of toilet and organic kitchen waste etc. - and coupling them with the right engineers/ scientists. This could be a more effective strategy, while at the same time constituting a more empowering experience for the participating actors. Process goals like these – actors learning to collaborate and to come up with creative solutions for their own situation – should be given the same attention as the content goals. Truly integrative and sustainable solutions can only be reached by exploration in niches in which deliberate experimentation takes place not only in technical, but also in social constellations. These experimentations should be accompanied by a collective learning process in which all parties are heard and their concerns taken seriously, but are also open to leave their dug-in positions.

What goes for this case, also goes for the development of transition theory itself: the study and design of *socio-technical* niches should be given more attention, to escape from a narrow technological focus on niches. Although creating processes of social learning is an explicit aim of Strategic Niche Management, it is always centred on the testing of a technology. Strategic Niche Management can be extended to a tool for the testing of new social constellations as well. This is equally important in managing transitions and reaching the end goal of sustainability.

7.4.2 Recommendations to the innovators

Improving network-building by breaking self-referentiality

Central to my recommendations to the proponents is the improvement of their network-building capacities, which should facilitate enrolment of new parties. Engineers should become aware that a role as network-builder requires a different form of communication and expertise. This is also increasingly realised in the network itself; through own analysis, analysis by other social scientists and the analysis of relative newcomers that are more used to work in a customer-oriented way and with other societal partners. But old patterns are persistent and so is the picture of alternative sanitation that lingers on with outsiders. Three essential points in improvement are all linked to breaking self-referentiality:

Firstly, breaking of self-referentiality with regard to the definition of the problems for which new sanitation is presented as a solution. The storyline of new sanitation as a technology for the recovery of water and nutrients is not understood nor shared by outsiders, since water nor nutrient scarcity is a priority issue in the Dutch context. Linking up to the water transition, showing that it is not so much about saving water, but dealing with water in more efficient and effective ways through source orientation, makes it more understandable for policymakers and the general public. Instead of clinging on to own arguments, one should look at what the ‘hot issues’ are for the parties one wants to enrol. And realise that this is not the same for all parties and that smart use should thus be made of the

'interpretative flexibility' of a project. For water boards better effluent quality against lower costs is the argument. But for a housing corporation this is not interesting at all, while image-building is. For VROM, the general public and the drinking water companies, public health is an issue, so the cost-efficient elimination of medicines and hormones through new sanitation can be emphasised. That new toilets or systems are equally or even more hygienic than conventional ones should be emphasised: in Germany this gave a boost to citizen-consumers' interest in urine-diverting toilets, as women were happy with a toilet that forced men to sit and thus not 'spatter'! Energy saving and even more sustainable energy generation⁴³ is a hot issue because of combating climate change. This can be exploited in several ways even though the quantities of energy generated by new sanitation are small: energy companies may be enrolled in areas where biomass digestion is seen as interesting; municipalities can incorporate this in their climate plans and it even fits in the transition policy of the Ministry of Economic Affairs. However, it is clear that economic arguments – if they can be underpinned with clear figures – are usually decisive if the threat is not eminent and should thus be given much more weight. Chances for Dutch business abroad by innovation here, is an argument used by companies like Landustrie and DeSaH BV themselves and is also interesting for EZ. If substantial cost-savings could be proven in investment costs in new neighbourhoods, in maintenance or in treatment, that would be passed on to municipalities, this would give a huge boost to further development. But at least it should be clarified that costs do not outweigh benefits: and this will have to be repeated and shown time and again to take away the general impression that currently exists of new sanitation as a very expensive environmental measure.

Secondly, breaking the self-referentiality with regard to the type of information presented: realizing that the data presented by the proponents are not adequate for policymakers. Of course the missing of information is partly due to the early state of developments and the uncertainty that this brings with it. But it should be kept in mind when deciding on the strategy for new research and the order in which research is conducted: more priority should be given to underpin the economic story and to showing how the technology could be embedded in the current material and immaterial infrastructure. To convince a policymaker a sound cost-benefit analysis and a report showing the full picture (from collection to final disposal) is more important than twenty reports on the efficiency of struvite precipitation. This may call for the attraction of other disciplines, like environmental economics. At the same time, it should be emphasised that questions on how tasks will be divided in a new system are open and can only be answered through consultation and participation in pilots from the different institutional parties, thereby explicitly inviting municipalities and water boards to enter in the discussion. Especially in communication towards VROM, RIZA and the municipalities, linking up new sanitation with the water transition and rainwater disconnection seems important, instead of presenting it as something that completely stands apart. Show them how this concept sits with rainwater disconnection: that it is something that could in certain areas be realized at the same time or could even make rainwater disconnection redundant, instead of implying an extra set of investments once we finally have reached rainwater disconnection.

Thirdly, to break self-referentiality the involved should realize that what is familiar and evident for them – namely the idea that sanitation could be organized completely different - is a completely new thought for an outsider, like a municipality invited to participate in a pilot. Getting this non-participant to regard itself as a "problem-owner" is a slow process that should be facilitated. In this process, it should become clear to the actor: what interest (where it touches its work terrain) or benefit is in it for him; what is desired from him or what concrete options he has to contribute to the project; and what this will cost him.

During the process, one should be conscious of the role of a true believer: its enthusiasm and drive can boost the process, but can easily generate to contra-productive arrogance when other parties feel that

⁴³ Renewable energy generation is sometimes said to be more 'sexy' than energy saving, attracting more investments (NRC Handelsblad, 21-02-2005, p. 3).

their worries have not been taken seriously. It should be realised that their resistance is often not based on ignorance or unwillingness, but by arguments that are perfectly reasonable within their decision-framework: and this may for a housing corporation indeed be the fact that the toilet can only be delivered in one colour! High risk perception due to unanswered questions on costs, benefits, further processing of urine and faeces and the complete picture of embedding (legal, technological, socio-cultural) of the technology, is also a reasonable argument for municipalities, water boards, housing corporations and national government agencies to be reluctant.⁴⁴ An impassioned view is prone to simplification: but a project initiator should show that he/she realizes that society and government as its representative has more issues to deal with, which have to be realised within the same tight budget. Threatening municipalities with the take-away of their mandate over sewerage is arrogant; it implies that they would not know what is best for society, because they choose to have other priorities. It would be far more constructive to strive for common solutions for the problem of under-capacity that they face.

Realizing the influence of context

In this respect it is important to realise that a project is never taking place in a vacuum, but that past experiences or the context can have significant influence on the willingness of parties to participate in a project. Blockage of the process can be caused by personal antipathies between the people involved or a bad history in consultation between the water board and municipality, but also by internal issues like budget reductions combined with a broadening of tasks. These things should be clarified and taken into account from the very beginning of the process on.

Impressions of alternative forms of sanitation on the basis of imagination or earlier (often half-heard) stories on composting toilets or digesting installations in the media are powerful and can also block the process. The innovators should not forget that for outsiders it is very hard to distinguish between the different projects. It is the innovator's task to show in clear images where his/her concept is different, in understandable language what it implies in practice and tackle misunderstandings. Ask people what they imagine, make their images explicit and show them where they are right or wrong.

Learning from pragmatism

The believers and engineers can learn from the more pragmatic advocators of new sanitation, like STOWA and Grontmij, who also have more experience in communicating to commercial partners and policy makers on different levels. Especially the 12 Ambachen, but also WASTE, LeAF and the environmental technology department of WUR, should be conscious of the danger of their current communication strategy: of coming across as too ideological in current times of pragmatism and as too ecological now that the attention for environmental issues is low. Their strategies work well when directed to the niche of the 'green' citizens, but as we have seen above often harm when directed to other parties. Much can be gained by combining their knowledge and enthusiasm with the more flashy strategy proposed by STOWA and Grontmij: dressing-up eco-sanitation as 'new sanitation' presented with a modern appearance of clean water, cost-efficiency and high comfort. Their pragmatism, instead of very radical anti-sewer stance, facilitates finding common interests with other parties and increases openness. They could thus have the function of a bridge between believers and the other parties in projects. Nonetheless, it might be a good investment to attract professional process managers or communication experts, who are themselves not involved in development of new sanitation and therefore not seen as biased. Money spent on good process management might pay off more than another technical research.

⁴⁴ The management of risks is crucial for any innovative building projects. Swart (Grontmij) stressed its importance and methods in his presentation on the PAO-course. (Wageningen, 18 th November 2005)

Broadening the transition arena

The recommendations on network-building should help to attract new parties. As has been argued extensively in 6.4 it is important to broaden the transition arena to include regime powers, especially municipalities, from an early stage. This is essential to prevent obstruction or delays during the implementation phase (like is now the case with rainwater disconnection) by: creating a sense of ‘co-ownership’ of the problem and incorporating their specific issues and expertise on integrate sewerage/sanitation with urban infrastructure. Municipalities are also needed for the experimentation with changes in fiscal measures and legal deviations.

Another recommendation is to broaden and diversify the arena involving organisations from outside the wastewater chain. The good example from some ecosan-actors to seek for broader coalitions with experts on nutrient or organic matter recycling is worth following. Because of the very low demand for nutrients in the Dutch context and regulatory issues, the search for a good disposal route for urine and faeces will be long, but is decisive for the further development of new sanitation. Starting now with the search for recycling options, can also contribute to closing the loop in the DESAR storyline. If innovators want to name phosphate recovery as an advantage of implementing their technique, they should also make sure they really got a customer for their struvite. Else the argument of nutrient recovery should be dropped – until the situation changes – as it only adds to the confusion about the need for alternative sanitation!

Organisations like Orgaworld and Amfert should therefore be approached in the near future – maybe after one pilot in which struvite is actually retrieved from urine⁴⁵ - at least for some explorative talks. They could help in the set-up of a pilot or defining research. Otherwise or next to this, experiments on local reuse should be started.

7.4.3 Recommendations to government and their advising bodies: preventing lock-in

Chief recommendation to the different administrative bodies and their advising bodies (the regime parties), would be to beware of lock-in and lock-in encouraging policies. It is good to be critical to new developments, but it is not good to reject them on the basis of unchecked assumptions (for example about the what ‘the’ citizen will accept), old information or sticking to the same heuristics. In the upcoming decades huge new investments are taking place for sewage renovation and rainwater sewers: especially now it is thus important to keep eyes wide open to note where innovations in black water separation could offer chances and be implemented at the same time. Water boards and municipalities should beware of being too risk-averse and conservative and should be open to experimentation with new concepts. The central government can keep a neutral position for the moment, but should define the goals of sustainability and create room and a wide playing field for innovations. Subsidies are not sufficient; also legal room for alternative grey or black water treatment is necessary and support should be given to local experimentation with sewage fee discounts and different set-up of water bills (like Waterspoor⁴⁶). Germany can be an example of rewarding citizens for taking responsibility and creating incentives for companies.⁴⁷ National government should take on a pro-innovation stance, thereby stimulating lower administrative bodies to enter into pilots.

⁴⁵ Plans for such a project exist in Hoogheemraadschap Rijnland and might be part from one of the Nieuwe Plassen-successor led by Grontmij. At www.stowa.nl the newest developments can be followed under the theme of Nieuwe Sanitatie.

⁴⁶ I do acknowledge the fierce criticism on Waterspoor by the wastewater sector (see also 6.2.2) and the so-called pull-out problematic (Dutch: afhaak-problematiek). However, not experimenting with these type of measures sustains the self-fulfilling prophesy that citizens do not want to change their behaviour: they might increasingly do so if their efforts are facilitated and rewarded, rather than blocked.

⁴⁷ Example: In Germany one can let a device be built into one’s house that disinfects grey water through UV, which can subsequently be used for flushing the toilet, mopping the floor, washing clothes and even showering. According to the selling company it has a payback time of ten years, amongst others thanks to the coupling of drinking water prices to wastewater treatment costs. www.pontos-aquacycle.com

RIONED could serve the needs of municipalities by (co)-conducting or financing research on cost savings that could be expected by applying new sanitation systems. Without choosing position, RIONED could also play a role in getting municipalities acquainted with the idea of new sanitation, by keeping them informed on the developments from this early stage – if only on their website.

We have seen how the current division of tasks in wastewater management between transport and treatment, both on the local/regional level and the national level, makes innovations that cross that barrier – like rainwater disconnection and in the future ecosanitation – harder to implement. However, solutions seem to lie in stimulating integration through further cooperation, rather than taking away municipalities' mandate over sewerage: threatening with this aggravates distrust and any split-ups will inevitably lead to new problems of policy fragmentation, in this case between sewerage and urban infrastructure planning. The set-up of Water plans and Wastewater pacts, coming to good divisions on rainwater disconnection financing and other ways of improving consultation should be stimulated as much as possible. The formation of water chain companies should be facilitated, but never forced upon.

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Interviews:

Date	Organisation	Person
31-08-2005	Thermpos International BV	W. Schipper
06-09-2005	WUR, Environmental Technology and LeAF	G. Zeeman, project leader DESAR
08-09-2005	BVOR (branche organization green composters)	J. Scholten J. Smout
13-09-2005	RIONED (knowledge institute sewage branche)	H. Gastkemper (RIONED)
21-09-2005	Grontmij	B. Swart, initiator "Nieuwe Plassen" project
22-09-2005	STOWA	B. Palsma (STOWA), subsidising DESAR and NP
04-10-2005	Waterschap Reest & Wieden	M. Kool, dike reef, participant NP-project
04-10-2005	Municipality Meppel	C. van de Bles, participant NP-project E. de Boer
13-10-2005	Amfert, artificial fertiliser company	C. Langeveld, managing director
24-10-2005	DSM-Agro	N. Heers, sales manager
26-10-2005	12 Ambachten	S. Leeftang, inventor Nonolet toilet
-	TU Delft	M. Loosdrecht, participant DESAR
02-11-2005	RIZA (national institute on integrated fresh water and wastewater management)	P. Vermij (RIZA)
10-11-2005	Orgaworld, composting/digestion	H. van Bomen, processing dried faeces from Nonolet toilets
15-12-2005	Zuid-Chemie	W. Wille
11-01-2006	NMI (Nutrient Management Institute)	T. van Dijke
17-01-2006	Stichting Mestverwerking Gelderland	H. van Veen
18-01-2006	Z-LTO Work group manure and minerals	M.Heijmans
19-01-2006	DG Water	K. Portegies-Boot
25-01-2006	VROM	G. Martijnse

Appendix: Checklist interviews

Involvement	<p>Degree of involvement in development of alternative sanitation</p> <p>Type of involvedness: research, pilot etc.</p> <p>Reasons, motivations for (un) involvedness</p> <p>Under which circumstances (outside/ inside pressures: more stringent norms, rising phosphate prices or other actors taking initiative) would one be prepared to enter in discussions, projects etc.</p>
Contacts and Cooperation	<p>With whom does contact or cooperation take place? Universities, wastewater managers, project developers, consultancies, outlet market for nutrients and organic waste etc.</p> <p>How can contact with each actor be classified? Close, reluctant, constructive etc.</p> <p>Reasons for non-cooperation with certain actors</p> <p>Who should be more involved/ is missing in the network?</p> <p>How can cooperation be improved?</p> <p>Management necessary? Who should manage?</p>
Coordination	<p>Ideas on the coherence of the network on alternative sanitation</p> <p>Fragmentation of research, pilots, policy</p>
Problem definition	<p>Positive and negative points of current system</p> <p>Need for system change?</p> <p>System change part of policy?</p>
View on alternatives	<p>Opinions on applicability and desirability of black water separation: can it tackle actor's priority issues?</p> <p>Opinions on dry toilets, composting, anaerobic digestion, vacuum toilets, urine-separation</p>
Transition	<p>Chances and impediments for a transition towards source-separation</p> <p>What is needed for such a transition to take place on level of organisation/ in general?</p>
Roles and responsibilities	<p>Who should take the lead/initiative in transition and why?</p> <p>Role of own organisation in each stage</p> <p>Expected/ desired role of other actors</p> <p>What should be the policy of central government?</p> <p>Is transition policy on sanitation/ wastewater chain alike the one for energy a good idea?</p>
Nutrient/ organic matter recycling	<p>Importance for alternative sanitation</p> <p>Demand for toilet waste, source-separated urine, struvite, compost, digestate</p> <p>Reasons for low/ high interest in nutrients etc. from toilet waste</p> <p>Criteria for acceptance</p>